SM7860

HIOKI

SM7860-51 SM7860-61
SM7860-52 SM7860-62
SM7860-53 SM7860-63
SM7860-54 SM7860-64
SM7860-55 SM7860-65
SM7860-56 SM7860-66
SM7860-57 SM7860-67
SM7860-58 SM7860-68

Instruction Manual

POWER SOURCE UNIT

Be sure to read this manual before using the device

Safety Information ▶ p. 4

When using the device for the first time

Part Names and Functions ▶ p. 10
Screen Configuration ▶ p. 13
Installation and Connection Procedures ▶ p. 15

Troubleshooting

Troubleshooting ▶ p. 53
Error Display ▶ p. 55

EN

July 2018 Revised edition 1
SM7860J961-01 18-07H

1.888.610.7664 www.calcert.com sales@calcert.com

Contents

Introduction 1
Notation 2
Verifying Package Contents 3
Safety Information 4
Operating Precautions 4

1 Overview 9

1.1 Product Overview and Features 9
1.2 Part Names and Functions 10
1.3 Screen Configuration 13

2 Preparation and Supply Power 15

2.1 Installation and Connection Procedures 15
2.2 Connecting the Power Cord 16
2.3 Connecting the Device to the Measuring Instrument 17
2.4 Inspection Before Operation 18
2.5 Turn ON/OFF the power 19
2.6 Operating Conditions Setting 20
2.7 Output Setting for the Device Interlocked 21

3 Changing the Interface 23

3.1 Overview and Features of the Interfaces 23
3.2 Interface Specifications 24
3.3 Connecting the Interface 26
Using the GP-IB Interface GP-IB 26
Using the RS-232C Interface RS-232C 26
3.4 Configuring the Communications Protocol 27
Configuring GP-IB Interface Communications GP-IB 27
Configuring RS-232C Interface Communications RS-232C 28
3.5 Communication Method 28
Status Byte Register 30
Event Register 31
Error Register 33
3.6 Message List 34
3.7 Listener Specification Precautions 36
Input buffer size 36
Reading from the output buffer 36

4 External Control 37

4.1 EXT I/O Connector and Signals 37
Connector Type and Signal Pinouts 38
Signal Functions 39
4.2 Timing Chart 40
4.3 Internal Circuitry 44

5 Specifications 45

5.1 General Specifications 45
5.2 Basic Specifications 46
Graph description and operating precautions 50
5.3 Input / Output Functions 52

6 Maintenance and Service 53

6.1 Troubleshooting 53
6.2 Error Display 55
6.3 Repairs, Inspections, and Cleaning 55
6.4 Replacing the Power Fuse 56

Warranty Certificate

1.888.610.7664 www.calcert.com sales@calcert.com

Contents

Introduction

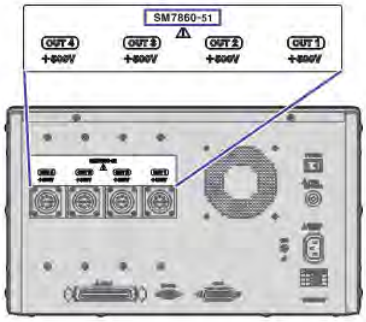
Thank you for purchasing the Hioki Model SM7860 series Power Source Unit.
To obtain maximum performance from the device over the long term, be sure to read this manual carefully and keep it handy for future reference.

Target audience

This manual has been written for use by individuals who use the product in question or who teach others to do so. It is assumed that the reader possesses basic electrical knowledge (equivalent to that of someone who graduated from the electrical program at a technical high school).

Finding the product's model number

You can find the model number on the rear of the device.



Model	Overview	Supply voltage
SM7860-51	500 V × 32 channels	100 V to 110 V
SM7860-52	1000 V × 32 channels	100 V to 110 V
SM7860-53	500 V × 16 channels, −500 V × 16 channels	100 V to 110 V
SM7860-54	1000 V × 16 channels, −1000 V × 16 channels	100 V to 110 V
SM7860-55	500 V × 8 channels, −500 V × 8 channels, discharge × 16 channels	100 V to 110 V
SM7860-56	1000 V × 16 channels, −1000 V × 16 channels, discharge × 16 channels	100 V to 110 V
SM7860-57	10 V × 24 channels, discharge × 8 channels	100 V to 110 V
SM7860-58	500 V × 24 channels, discharge × 8 channels	100 V to 110 V
SM7860-61	500 V × 32 channels	220 V
SM7860-62	1000 V × 32 channels	220 V
SM7860-63	500 V × 16 channels, −500 V × 16 channels	220 V
SM7860-64	1000 V × 16 channels, −1000 V × 16 channels	220 V
SM7860-65	500 V × 8 channels, −500 V × 8 channels, discharge × 16 channels	220 V
SM7860-66	1000 V × 16 channels, −1000 V × 16 channels, discharge × 16 channels	220 V
SM7860-67	10 V × 24 channels, discharge × 8 channels	220 V
SM7860-68	500 V × 24 channels, discharge × 8 channels	220 V

1.888.610.7664 www.calcert.com sales@calcert.com

Notation

Concerning Safety

In this document, the risk seriousness and the hazard levels are classified as follows.

⚠ DANGER	Imminent risk of operator death or serious injury
⚠ WARNING	Potential for operator death or serious injury
⚠ CAUTION	Potential for minor operator injury or device damage or malfunction
IMPORTANT	Indicates information related to the operation of the device or maintenance tasks with which the operators must be fully familiar.
🛇	Prohibited actions
❗	Actions that must be performed

Symbols Affixed to the Device

⚠	Precaution or hazard (See “Operating Precautions”.)
I	ON side of the power switch
O	OFF side of the power switch
~	AC (alternating current)
⏚	Grounding terminal

Others

*	Additional information is presented below.
p.	Indicates the location of reference information.
[ ]	Key names are indicated in brackets.
ON	Names and keys on the screen are shown in boldface.

Accuracy

We define measurement tolerances in terms of f.s. (full scale), rdg. (reading), and dgt. (digit) values, with the following meanings:

f.s.	f.s. (maximum display value) The maximum displayable value. This is usually the name of the currently selected range.
rdg.	rdg. (reading or displayed value) The value currently being measured and indicated on the measuring device.
dgt.	dgt. (resolution) The smallest displayable unit on a digital measuring device, i.e., the input value that causes the digital display to show a “1” as the least-significant digit.

1.888.610.7664 www.calcert.com sales@calcert.com

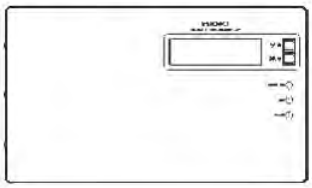
Verifying Package Contents

When you receive the device, inspect it carefully to ensure that no damage occurred during shipping. In particular, check the accessories, panel switches, and connectors. If damage is evident, or if it fails to operate according to the specifications, contact your authorized Hioki distributor or reseller.

Device and Accessories

Confirm that you have received the following items:

- ☐ Model SM7860 series Power Source Unit



- ☐ Power cord
- ☐ Instruction Manual (This document)

Options

The following options are available for the device. Contact your authorized Hioki distributor or reseller when ordering.

☐ Model 9637	RS-232C Cable (9pin-9pin/1.8 m)	Cross
☐ Model 9151-02	GP-IB Connector Cable	2 m
☐ Model L2221	Connector	Voltage output

1.888.610.7664 www.calcert.com sales@calcert.com

Safety Information

Before using the device, be certain to carefully read the following safety notes.

⚠ DANGER

Mishandling during use could result in injury or death, as well as damage to the device. Be certain that you understand the instructions and precautions in the manual before use.

⚠ WARNING

- **With regard to the electricity supply, there are risks of an electric shock, heat generation, fire, and arc flash due to a short-circuit. Individuals using an electrical measuring device for the first time should be supervised by a technician who has experience in electrical measurement.**
- **Protective gear**
  This device is measured on a live line. To prevent an electric shock, use appropriate protective insulation and adhere to applicable laws and regulations.

Operating Precautions

Follow these precautions to ensure safe operation and to obtain the full benefits of the various functions.

Checks before use

⚠ DANGER

If the connection cord or the device is damaged, there is a risk of an electric shock. Perform the following inspection before using the device:

- **Check that the coatings of the connection cords are neither ripped nor torn and that no metal parts are exposed. Using the device under such conditions could result in an electric shock. Replace the connection cords with those specified by our company.**
- **Verify that the device operates normally to ensure that no damage occurred during storage or shipping. If you find any damage, contact your authorized Hioki distributor or reseller.**

⚠ WARNING

To prevent an electric shock, confirm that the white or red portion (insulation layer) inside the cable is not exposed. If a color inside the cable is exposed, do not use the cable.

1.888.610.7664 www.calcert.com sales@calcert.com

Installing the device

⚠ WARNING

- **Ventilation holes for heat radiation are provided on the side and rear panels of the device. Leave sufficient space around the ventilation holes and install the device with the holes unobstructed. Installation of the device with the ventilation holes obstructed may cause a malfunction or a fire.**
- **Unplugging the power cord kills power to the device. Be sure to provide enough unobstructed space to unplug the power cord immediately in an emergency.**

Installing the device in inappropriate locations may cause a malfunction of device or may give rise to an accident. Avoid the following locations:

- **Exposed to direct sunlight or high temperature**
- **Exposed to corrosive or combustible gases**
- **Exposed to a strong electromagnetic field or electrostatic charge**
- **Near induction heating systems (such as high-frequency induction heating systems and IH cooking equipment)**
- **Susceptible to vibration**
- **Exposed to water, oil, chemicals, or solvents**
- **Exposed to high humidity or condensation**
- **Exposed to high quantities of dust particles**

⚠ CAUTION

Failure to observe the following precaution may result in bodily injury.

- The device weighs approx. 47 kg (Model SM7860-57 and SM7860-67: approx. 34 kg). It should be moved by at least two people, who should grip it using the handles on the left and right sides. The center of gravity is located on the front side of the device.
- The device is heavy. When transporting it, follow your company's workplace safety standards to assure safety (for example, by wearing non-slip gloves and protective footwear).

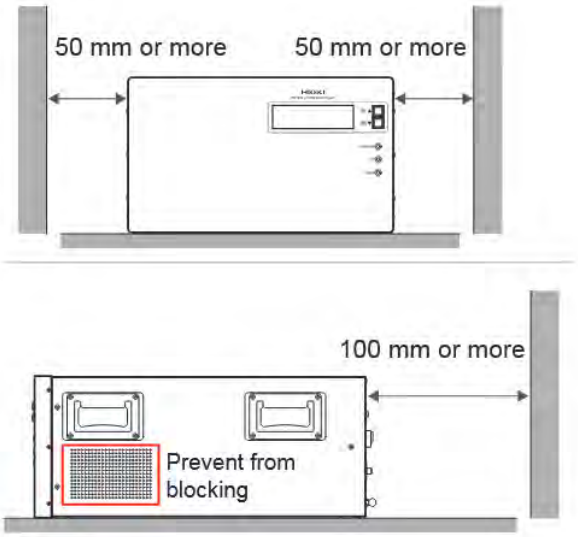
Do not place the device on an unstable table or inclined place. Dropping or knocking down the device can cause injury or damage to the device.

1.888.610.7664 www.calcert.com sales@calcert.com

Installing

Prolonged operation in hot temperatures will shorten the device's service life. Keep the ambient temperature as low as possible.

- Avoid obstructing the ventilation holes.
- To prevent overheating, be sure to leave the specified clearances around the device.
- When rack-mounting the device, fans must be installed above or on top of the rack to ensure proper ventilation. Be sure that the rack is adequately ventilated so that the internal temperature remains at or below 40°C.



Handling the Device

⚠ DANGER

- **Do not use the device with circuits that exceed its ratings or specifications. Doing so may damage the device or cause it to become hot, resulting in a bodily injury.**
- **Do not short-circuit two wires to be measured by bringing the cable into contact with them. Arcs or such grave accidents are likely to occur.**

⚠ CAUTION

Failure to observe the following precaution may result in bodily injury.

- The device weighs approx. 47 kg (Model SM7860-57 and SM7860-67: approx. 34 kg). It should be moved by at least two people, who should grip it using the handles on the left and right sides. The center of gravity is located on the front side of the device.
- The device is heavy. When transporting it, follow your company's workplace safety standards to assure safety (for example, by wearing non-slip gloves and protective footwear).

1.888.610.7664 www.calcert.com sales@calcert.com

Handling the Cords

⚠ WARNING

If the insulation on a cord melts, the metal conductor may be exposed. Do not use any cord whose metal conductor is exposed. Doing so could result in an electric shock, burn, or other hazards.

⚠ CAUTION

To avoid damaging the power cord, grasp the plug, not the cord, when unplugging it from the outlet or device.

To prevent cord damage, do not step on cords or pinch them between other objects. Do not bend or pull on cables at their base.

IMPORTANT
Use only the specified connection cords. Use of any cable not specified by our company may result in incorrect measurements due to poor connection or other reasons.

To ensure accurate measurements

- Warm up the device an hour or more before use.
- The device should be calibrated once a year.

Transporting Precautions

- To ensure safe handling, when transporting the device, please use the original box and packing materials, but do not use if the box is damaged or warped, or if the packing materials are in poor condition or incomplete.
- When packing the device, make sure to disconnect power supply cords from the main device.
- When transporting, avoid dropping or other excessive impacts.

1.888.610.7664 www.calcert.com sales@calcert.com

1 Overview

1.1 Product Overview and Features

The SM7860 series Power Source Unit is a power source designed for use with the SM7420 Super Megohm Meter and SM7810-20 Super MΩ HiTester. When used in conjunction with the SM7420 or SM7810-20, the SM7860 serves as an ideal power source for automatic testing and measurement of capacitors.

Positive- and negative-polarity output / Multi-channel output

- The device supports multichannel systems with up to 32 channels.
- The output voltage can be set separately for two circuits, each consisting of 8 or 16 channels.
- The device provides both positive- and negative-polarity power sources.
- It can be used to create an optimal testing line with the minimum necessary number of power sources.

Independent on/off output switching and current limitations for all channels

- Since each channel has its own output on/off switch, it is possible to control voltage application without an external circuit (allowing charging and discharging).
- Use of semiconductor switches eliminates the need for maintenance.
- Ability to limit current for individual channels means the measurement of other channels won't be affected when a target workpiece has a short.

Variable output current limit value

- 500 V output model: The output current limit can be set as desired from 2 mA per channel to 50 mA per channel.
- 1000 V output model: The output current limit can be set as desired from 2 mA per channel to 10 mA per channel.

1000 V output voltage model

- The line includes a model that can generate output of up to ±1000 V.

High-current output at 50 mA/channel*

- The device can quickly charge high-capacity MLCC (multi-layer ceramic capacitor). Number of charges can be reduced.

  * For the 1000 V model, limited to 10 mA/channel.

Standard interfaces

- Devices ship standard with EXT. I/O, GP-IB, and RS-232C interfaces for sequencing. Interfaces are used to configure and power the device.

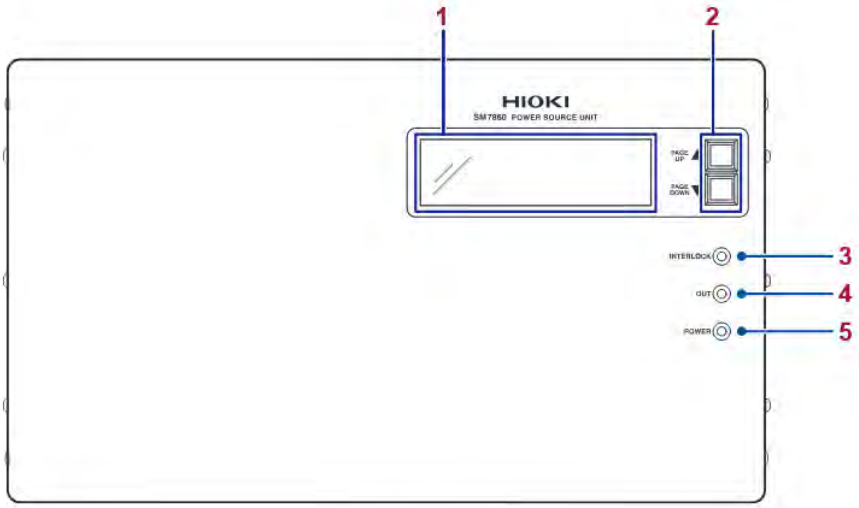
Interlock function

- Since the device outputs measurement and charging voltages when measurement starts, erroneous operation poses the risk of electric shock. An interlock function is used to ensure safe measurement. Settings can be configured by sending signals via the device's external I/O interface.

1.888.610.7664 www.calcert.com sales@calcert.com

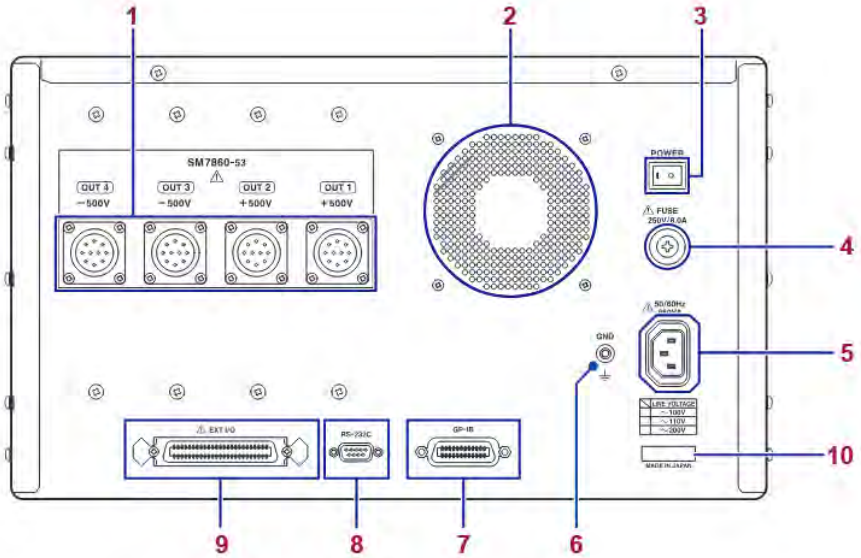
1.2 Part Names and Functions

Front



1	Display (LCD)	The screen uses a 2-page layout to display setting values and setting status information. Refer to “1.3 Screen Configuration” (p. 13)
2	Scroll keys **[PAGE UP▲], [PAGE DOWN▼]**	• Use to scroll the display (LCD). Refer to “1.3 Screen Configuration” (p. 13) • Used to assign the GP-IP address and to configure the output setting for the device interlocked. Refer to “Configuring GP-IB Interface Communications GP-IB” (p. 27)
3	Interlock indicator (INTERLOCK)	Lights up when the interlock is on.
4	Voltage output indicator (OUT)	Lights up when a voltage is being output.
5	Power indicator (POWER)	Lights up when the device is on.

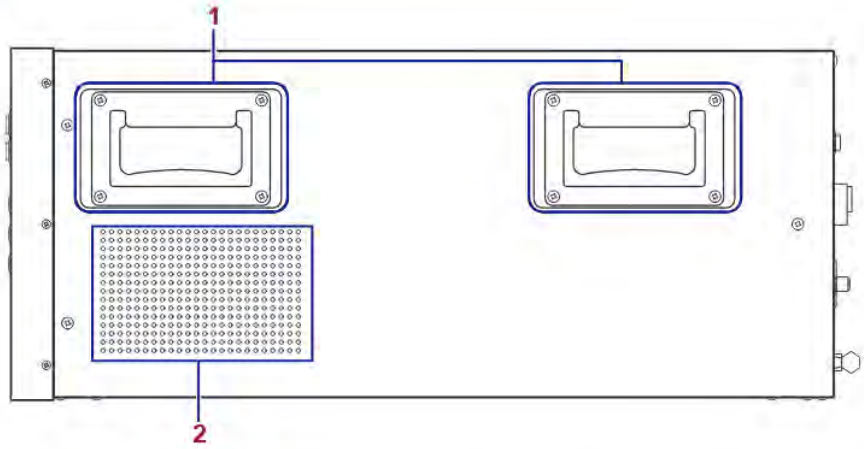
Rear



1	Voltage output terminal	Voltage is output. Connect the optional Model L2221 Connector. Refer to “2.3 Connecting the Device to the Measuring Instrument” (p. 17)
2	Ventilation holes	Keep clear of obstructions. Refer to “Installing” (p. 6)
3	Power switch (POWER)	Turns the device on and off. I : Power ON O : Power OFF Refer to “2.5 Turn ON/OFF the power” (p. 19)
4	Fuse holder (FUSE)	Fuse can be replaced. Refer to “6.4 Replacing the Power Fuse” (p. 56)
5	Power inlet	Connect the supplied power cord. Refer to “2.2 Connecting the Power Cord” (p. 16)
6	GND terminal	Serves as the ground terminal. Connects to the device’s enclosure.
7	GP-IB connector	Connect to a PC when using the GP-IB interface. Refer to “Using the GP-IB Interface GP-IB” (p. 26)
8	RS-232C connector	Connect to a PC when using the RS-232C interface. Refer to “Using the RS-232C Interface RS-232C” (p. 26)
9	EXT I/O connector	The EXT I/O connector can be used to control the device. Refer to “4 External Control” (p. 37)
10	Serial number	The serial number consists of 9 digits. The first two (from the left) indicate the year of manufacture, and the next two indicate the month of manufacture. Required for production control. Do not peel off the label.

1.888.610.7664 www.calcert.com sales@calcert.com

Side



1	Handle (total of 4, located on the left and right sides of the device)	It should be moved by at least two people, who should grip it using the handles on the left and right sides.
2	Ventilation holes	Keep clear of obstructions. Refer to “Installing” (p. 6)

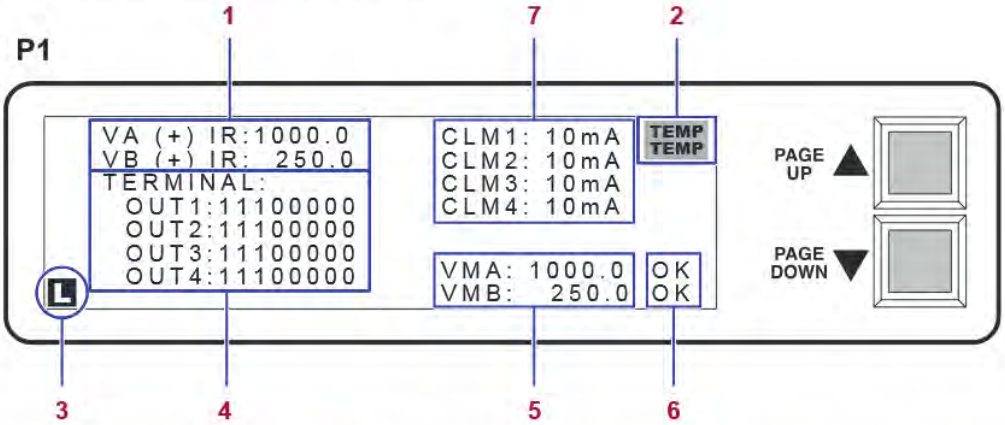
1.888.610.7664 www.calcert.com sales@calcert.com

1.3 Screen Configuration

The display (LCD) consists of two display pages (Screen P1, Screen P2).

- Screen P1 is displayed when the device is turned on.
- The display pages can be scrolled using the scroll keys (**[PAGE UP ▲]**, **[PAGE DOWN ▼]**) to the right of the screen.
- You can select a display page directly by sending a "**PAG**" command from the GP-IB or RS-232C interface. Refer to "3.6 Message List" (p. 34)

Screen P1: Displays output voltage settings

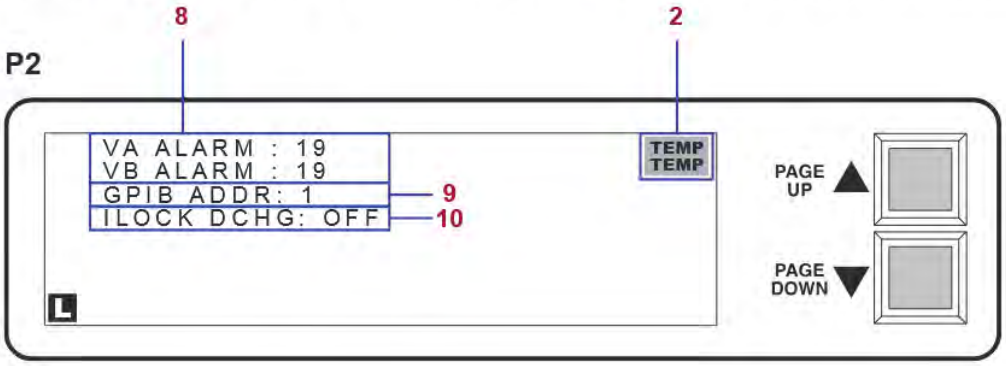


1	Output voltage setting	**VA** : Displays the power supply A circuit voltage setting. **VB** : Displays the power supply B circuit voltage setting. (Display example: **VA (+) IR: 1000.0** Indicates that the power source's A circuit is set to 1000.0 V.)
2	Temperature error display	When a temperature error is detected, **TEMP** blinks.
3	Key lock display	When the keys are locked, **L** is displayed.
4	Terminal output setting state	Displays rows 1 through 8 of **OUTn** (where n indicates a value from **1** to **4**), from left to right. The setting is **0** or **1**. **0** : High-impedance **1** : ON
5	Monitor voltage value	**VMA** : Voltage monitor value for the power supply A circuit. **VMB** : Voltage monitor value for the power supply B circuit. The zero decimal point's position is fixed using zero suppression.
6	Voltage error alarm results	**OK**: The monitor voltage (**5**) error relative to the output voltage setting (**1**) falls within the normal range relative to the voltage error alarm setting (**8**, p. 14). **NG**: The monitor voltage (**5**) error relative to the output voltage setting (**1**) indicates an error relative to the voltage error alarm setting (**8**, p. 14).

1.888.610.7664 www.calcert.com sales@calcert.com

7	Output current limit value	**CLM1** : OUT1 output current limit value setting display **CLM2** : OUT2 output current limit value setting display **CLM3** : OUT3 output current limit value setting display **CLM4** : OUT4 output current limit value setting display The digit following **CLM** corresponds to OUT1 to 4. (Display example: **CLM1: 10mA** Indicates that the current output from OUT1 is limited to 10 mA.)

Screen P2: Displays alarms, the GP-IP address, and output setting for the device interlocked.

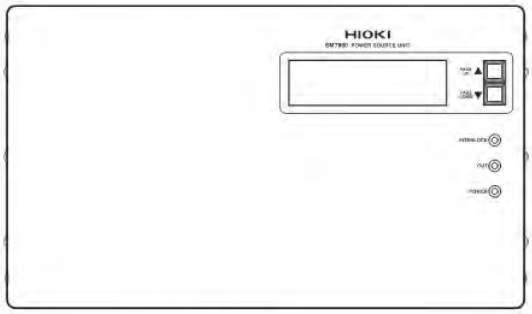


2	Temperature error display	When a temperature error is detected, **TEMP** blinks.
8	Voltage error alarm setting	**VA ALARM** : Power supply A circuit voltage error alarm setting ± (%) **VB ALARM** : Power supply B circuit voltage error alarm setting ± (%)
9	GP-IB address	Refer to “Using the GP-IB Interface GP-IB” (p. 26)
10	Output setting for the device interlocked	Refer to “2.7 Output Setting for the Device Interlocked” (p. 21)

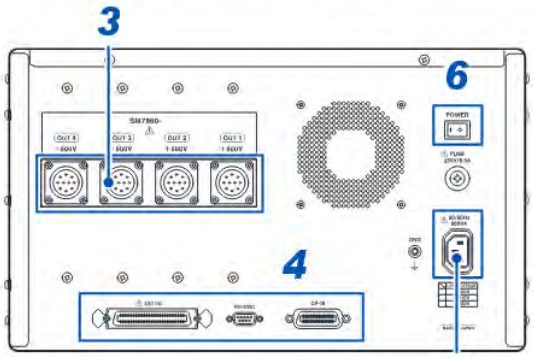
2 Preparation and Supply Power

2.1 Installation and Connection Procedures

Be sure to read the “Operating Precautions” (p. 4) before installing and connecting the device.



Front



Rear

1 **Install the device. (p. 5)**

↓

2 **Connect the power cord. (p. 16)**

↓

3 **Connect the device to the measuring instrument. (p. 17)**

↓

4 **Connect the external interface.**

- Using the GP-IB or RS-232C interface (p. 23)
- Using the EXT I/O (p. 37)

↓

5 **Complete the pre-use inspection. (p. 18)**

Be sure to inspect the device prior to use.

↓

6 **Turn the power on. (p. 19)**

↓

7 **Make device settings. (p. 20)**

(via the external interface)

↓

8 **Activate the power source.**

1.888.610.7664 www.calcert.com sales@calcert.com

2.2 Connecting the Power Cord

⚠ WARNING

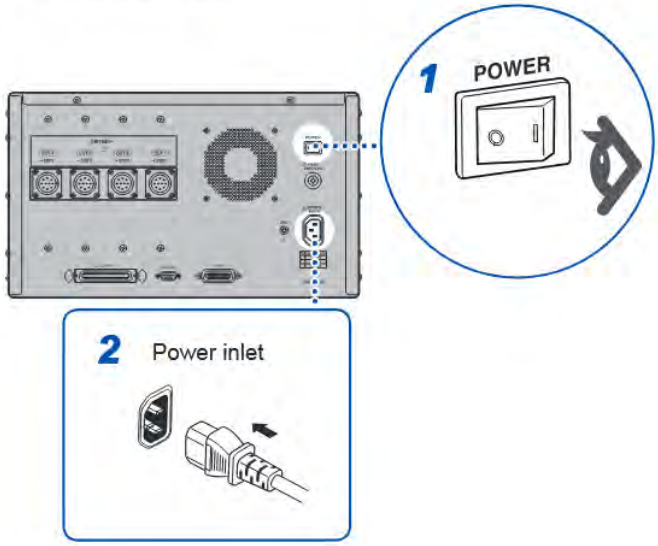
- **Before turning the device on, make sure the supply voltage matches that indicated on its power connector. Connection to an improper supply voltage may damage the device and present an electrical hazard.**
- **To prevent an electric shock and to maintain the safety specifications of this device, connect the power cord provided only to an outlet.**
- **Before using the device, make sure that the insulation on the power cord is undamaged and that no bare conductors are improperly exposed. Using the device in such conditions could cause an electric shock, so replace the power cord with those specified by our company.**

⚠ CAUTION

To avoid damaging the power cord, grasp the plug, not the cord, when unplugging it from the outlet or device.

Turn off the power before disconnecting the power cord.

Connection Method



1. **Confirm that the device is turned off.**
2. **Confirm that the supply voltage matches the device, and connect the power cord to the power inlet on the device.**
3. **Plug the power cord into the outlet.**

This completes the process of connecting the power cord.

2.3 Connecting the Device to the Measuring Instrument

⚠ WARNING

To prevent an electric shock or damage to the equipment, always observe the following precautions when connecting to voltage output terminal:

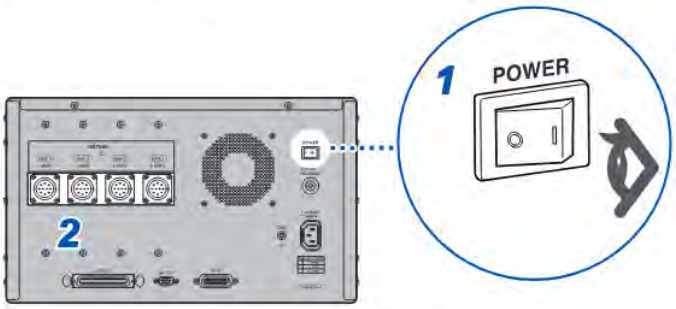
- **Always turn off the device and any devices to be connected before connecting the voltage output connectors.**

⚠ CAUTION

To avoid damage to the device, be sure to observe the following precautions:

- Do not connect the device to a load with a charge in excess of the output voltage range.
- Do not connect the device to a load with a charge that has the opposite polarity of the output voltage range.
- Do not connect the device to a load that has a charge when the device is turned off.

Connection Method



1 **Confirm that the device is turned off.**

2 **Connect model L2221 Connector*1 (optional) to the voltage output terminal on the rear of the device.**

This completes the process of connecting the device to the measuring instrument.

*1: Refer to "Voltage output pin assignment specifications" described below to modify the L2221 to connect measurement targets.

Voltage output pin assignment specifications

Pin No.	OUT1 Circuit A	OUT2*1 Circuit A	OUT3 Circuit B	OUT4*2 Circuit B
1	CH1	CH1	CH1	CH1
2	CH2	CH2	CH2	CH2
3	CH3	CH3	CH3	CH3
4	CH4	CH4	CH4	CH4
5	CH5	CH5	CH5	CH5
6	CH6	CH6	CH6	CH6
7	CH7	CH7	CH7	CH7
8	CH8	CH8	CH8	CH8
9	NC	NC	NC	NC
10	COM	COM	COM	COM

*1: On the SM7860-55, -56, -65, and -66, serves as the discharging terminal.

*2: On the SM7860-55, -56, -57, -58, -65, -66, -67, and -68, serves as the discharging terminal.

2.4 Inspection Before Operation

Verify that the device operates normally to ensure that no damage occurred during storage or shipping. If you find any damage, contact your authorized Hioki distributor or reseller.

Inspection of peripheral devices

- Is the power cord insulation torn, or is any metal exposed?
- Is the connection cord insulation torn, or is any metal exposed?

Exposed → Do not use them if they are damaged because it may cause an electric shock. (Replace with a new cord.)

Not exposed ↓

Inspection of device

Is there any damage on the device?

Yes → If any, request repair.

No ↓

Does the supply voltage of your power source match the supply voltage indicated on the power source inlet on the rear of the device?

No → Use of a supply voltage outside the specified range may damage the device or cause an electric shock.

Yes ↓

The inspection is complete.

Please read the “Operating Precautions” (p. 4) before use.

2.5 Turn ON/OFF the power

⚠ WARNING

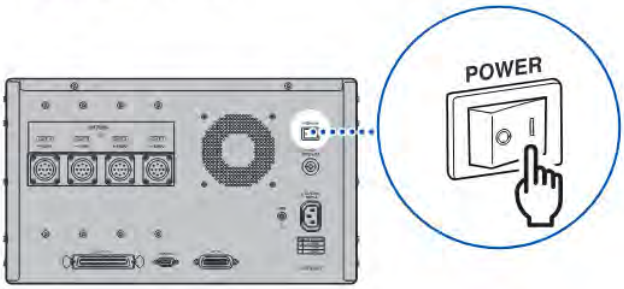
Before turning the device on, make sure the supply voltage matches that indicated on its power connector. Connection to an improper supply voltage may damage the device and present an electrical hazard.

When turning the device on and off, do not touch the voltage output terminals. Doing so may cause an electric shock.

⚠ CAUTION

When turning the device on and off, do not connect a load to the voltage output terminals. Turning the device on or off with a load connected may damage the load.

Turn on the power

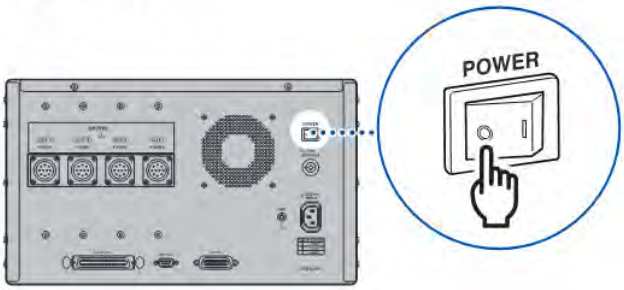


Turn on the power switch.
The power indicator and display (LCD) on the front of the device will light up.

Before Starting Measurement

To obtain precise measurements, provide about an hour warm-up after turning on the power.

Turn off the power



Turn off the power switch.

2.6 Operating Conditions Setting

This section describes how to set the operating conditions according to the manner in which the device is to be used. Settings are configured via either of the device's external interfaces:
Refer to "3 Changing the Interface" (p. 23)

The device cannot be configured directly in a standalone manner.

Setting function	Description of operation and settings	Reference
Output voltage	Sets the output voltage. Setup ranges: 1.0 V to 1000.0 V (0.1 V resolution)	p. 34
Voltage error alarm	Generates an alarm when the monitor voltage error relative to the output voltage setting falls outside the set value range. Setup ranges: ±2 to ±19% (1% resolution)	p. 34
LCD display mode	Turns the LCD display on and off. OFF/ ON	p. 35

1.888.610.7664 www.calcert.com sales@calcert.com

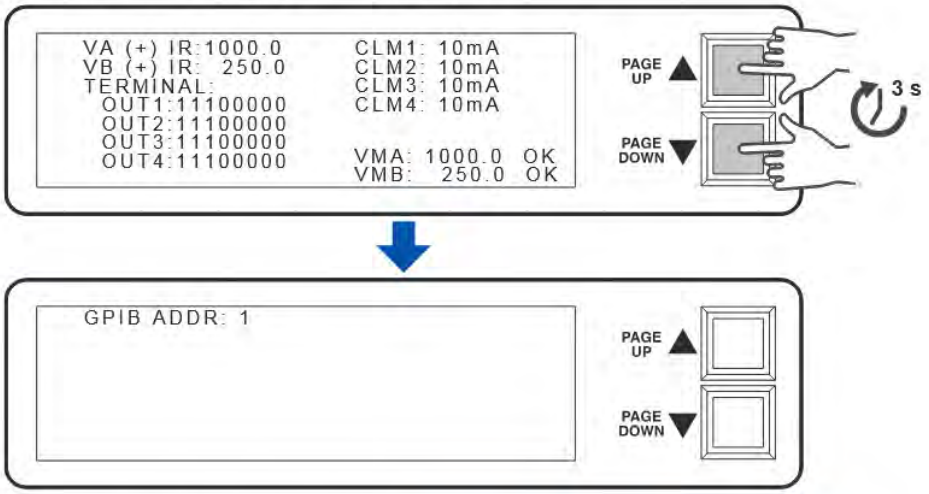
2.7 Output Setting for the Device Interlocked

This section describes how to choose between an impedance state and a discharging state for the output with the device interlocked.
This setting remains the same even after the device is initialized.

ILOCK DCHG: OFF	High-impedance state (Default)
ILOCK DCHG: ON	Discharging state

1 **Press and hold both of the scroll keys ([PAGE UP▲] and [PAGE DOWN▼]) on the right of the screen simultaneously for approx. 3 s.**

(The address can be set from the P1 or P2 screen.)
The GP-IB-address assigning screen is displayed.

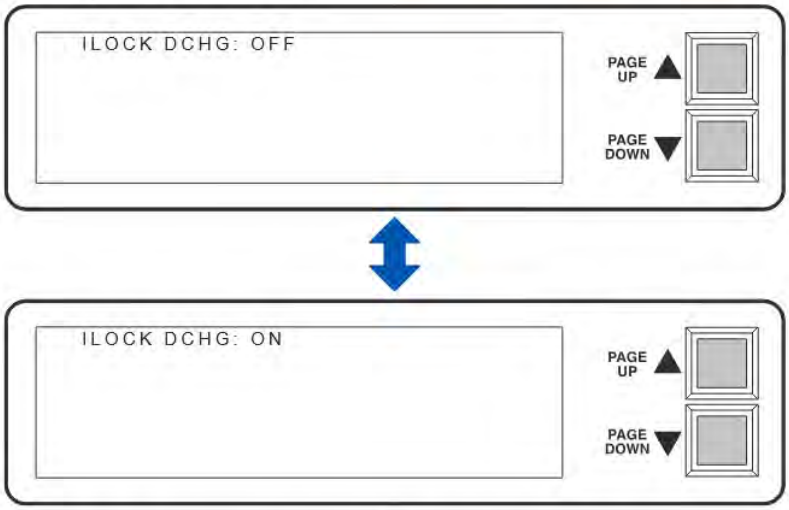


2 **Press and hold both the scroll keys ([PAGE UP▲] and [PAGE DOWN▼]) again simultaneously for 3 s.**

The setting screen for the output setting for the device interlocked is displayed.

3 **Press either of the scroll keys ([PAGE UP▲] or [PAGE DOWN▼]).**

The output state is switched.



4 **Turn off the device once you have finished configuring the settings.**

3 Changing the Interface

The mark shown below indicates that the following instructions are specific to the RS-232C or the GP-IB interface. Instructions without these symbols are for both the RS-232C and the GP-IB interface.

GP-IB : GP-IB interface only
RS-232C : RS-232C interface only

Before communicating

When connecting a GP-IB or RS-232 cable, be sure to secure the connector in place with screws or other appropriate hardware.
When issuing commands that contain data, make sure that the data is provided in the specified format.

1 **Connect the cable. (p. 26)**

Connect the device and controller (PC etc.) with a GP-IB connection cable or RS-232C interface cable.

2 **Set the communications protocol.**

GP-IB **Enter a GP-IB address. (p. 27)**

RS-232C **Set the device to the same communications protocol as the controller (PC etc.). (p. 28)**

3 **Set the transmission format.**

3.1 Overview and Features of the Interfaces

The device provides standard communication functionality in the form of GP-IB and RS-232C interfaces, both of which can be used to control the device remotely and to transfer data.

GP-IB This device is designed with reference to the following standard:
Reference standard IEEE 488.1-1987

1.888.610.7664 www.calcert.com sales@calcert.com

3.2 Interface Specifications

Precautions

RS-232C and GP-IB communications cannot be used simultaneously.

(1) GP-IB Specifications GP-IB

- Electrical machinery specifications: IEEE std. 488.1-1987 compliant
- Address setting: Can be set to talker/listener addresses 1 to 30.

Interface Functions

✓: Available, – : Unavailable

SH1	Source handshake functions (all)	✓
AH1	Acceptor handshake functions (all)	✓
T6	Basic talker functions Serial poll function Talk-only mode The talker cancel function with MLA (My Listen Address)	✓ ✓ – ✓
L4	Basic listener functions Listen-only mode The listener cancel function with MTA (My Talk Address)	✓ – ✓
SR1	Service request functions (all)	✓
RL1	Remote/Local functions (all)	✓
PP0	Parallel poll function	–
DC1	Device clear functions (all)	✓
DT1	Device trigger functions (all)	✓
C0	Controller function	–
E2	Tri-state output	

Operating code: ASCII codes

1.888.610.7664 www.calcert.com sales@calcert.com

(2) RS-232C Specifications RS-232C

Transfer method	Communication method: Full duplex Synchronization method: Asynchronous		
Transmission rate	38400 bps fixed		
Data bit length	8 bits		
Stop bit	1 bit		
Parity bit	None		
Delimiter	Transmit: CR+LF Receive: CR, CR+LF		
Flow control	No X flow control, no hardware flow control		
Protocol	TTY		
Electrical specification	Input voltage level	5 V to 15 V:	ON
		−15 V to −5 V:	OFF
	Output voltage level	+5 V or more:	ON
		−5 V or less:	OFF
Connector	Male 9-pin D-sub, with #4-40 attachment screws, The I/O connector is a DTE (Data Terminal Equipment) configuration Recommended cable: Model 9637 RS-232C Cable (9 pin-9 pin/1.8 m) Refer to “3.3 Connecting the Interface” (p. 26)		

Operating code: ASCII codes

1.888.610.7664 www.calcert.com sales@calcert.com

3.3 Connecting the Interface

⚠ WARNING

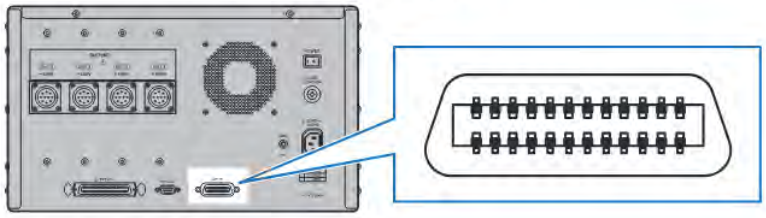
- **To avoid equipment failure, do not disconnect the communications cable while communications are in progress.**
- **Use a common ground for both the device and the PC. Using different ground circuits will result in a potential difference between the device's ground and the PC's ground. If the communications cable is connected while such a potential difference exists, it may result in equipment malfunction or failure.**
- **Before connecting or disconnecting any communications cable, always turn off the device and the PC. Failure to do so could result in equipment malfunction or damage.**
- **After connecting the communications cable, tighten the screws on the connector securely. Failure to secure the connector could result in equipment malfunction or damage.**

⚠ CAUTION

To avoid damage to the device, do not short-circuit the terminal and do not input voltage to the terminal.

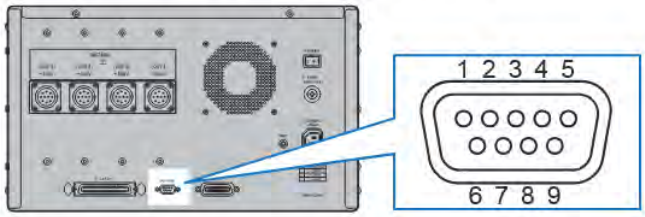
Using the GP-IB Interface GP-IB

Connect the GP-IB cable to the GP-IB connector.
Recommended cable: Model 9151-02 GP-IB Connector Cable (2 m)



Using the RS-232C Interface RS-232C

Connect the RS-232C cable to the RS-232C connector.
Recommended cable: Model 9637 RS-232C Cable (9 pin-9 pin/1.8 m)



Pin No.	Signal Name			Signal	Remarks
	Common name	EIA	JIS		
1	DCD	CF	CD	Carrier detect	Unused
2	RxD	BB	RD	Receive data	
3	TxD	BA	SD	Transmit data	
4	DTR	CD	ER	Data terminal ready	Unused
5	GND	AB	SG	Signal ground	
6	DSR	CC	DR	Data set ready	Unused
7	RTS	CA	RS	Request to send	Unused
8	CTS	CB	CS	Clear to send	Unused
9	RI	CE	CI	Ring indicator	Unused

1.888.610.7664 www.calcert.com sales@calcert.com

When connecting the device to a PC

Use a crossover cable with female 9-pin D-sub connectors.
Crossover Wiring

Female 9-pin D-sub
SM7860 side

	Pin No.
DCD	1
RxD	2
TxD	3
DTR	4
GND	5
DSR	6
RTS	7
CTS	8
RI	9

Female 9-pin D-sub
PC/AT Enhanced
Graphics Adapter

Pin No.	
1	DCD
2	RxD
3	TxD
4	DTR
5	GND
6	DSR
7	RTS
8	CTS
9	RI

Recommended cable:
Model 9637 RS-232C Cable (9 pin-9 pin/1.8 m)

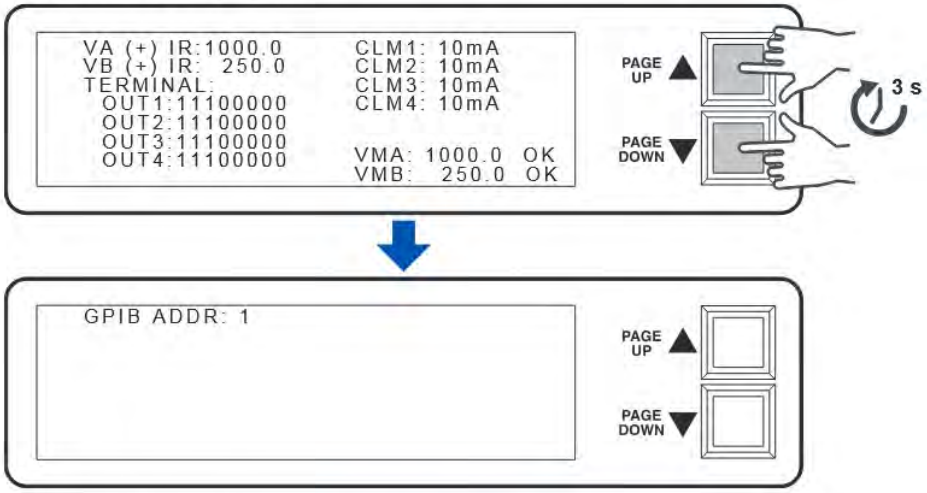
3.4 Configuring the Communications Protocol

Configuring GP-IB Interface Communications GP-IB

Setting the GP-IB address

1 **Press and hold both of the scroll keys ([PAGE UP▲] and [PAGE DOWN▼]) on the right of the screen simultaneously for approx. 3 s.**

(The address can be set from the P1 or P2 screen.)
The setting screen is displayed.



2 **Press either of the scroll keys ([PAGE UP▲] or [PAGE DOWN▼]), set the desired address. (Valid setting range: 1 to 30)**

3 **Turn off the device once you have finished configuring the settings.**

Configuring RS-232C Interface Communications RS-232C

Set the communications protocol on the controller (PC, etc.) to the same communications settings. For more information about how to configure these settings, refer to the controller's instruction manual or other documentation.

Communication conditions

Baud rate	38400 bps
Parity	none
Stop bit	1 bit
Data	8 bits
Flow control	none

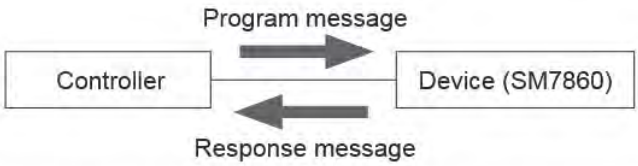
Remote switching requests

Send the RMT command from the RS-232C interface.
RS-232C interface communications will not be available until the RMT command is sent.

3.5 Communication Method

Various messages are supported for controlling the device through the interfaces.

Messages can be either program messages, sent from the controller such as PC to the device, or response messages, sent from the device to the controller.



Message types are further categorized as follows.

When issuing commands that contain data, make certain that the data is provided in the specified format.

Program Messages

1. Command Messages and Query Messages

   Command Messages

   Commands that control the device, for example to configure settings or reset the device.

   Query Messages

   Requests for responses relating to results of operation or measurement, or the state of device settings.
   Query commands end with a question (?) mark.
2. Message delimiter (terminator)

   This device recognizes the following input message delimiters:
   LF with CR+EOI
   LF with EOI
   CR with EOI
   EOI
   CR+LF
   LF

Response Messages

1. Response Messages

   When a query message is received, its syntax is checked and a response message is generated.
2. Message delimiter (terminator)

   The following three response message delimiters can be specified with the "DLM" command:
   LF (initial setting)
   CR+LF
   EOI

Separators

1. Message Unit Separator

   Multiple message can be written in one line by separating them with semicolons " ; ".
2. Header Separator

   In a message consisting of both a header and data, the header is separated from the data by a space (ASCII code 20H).
3. Data Separator

   In a message containing multiple data items, commas "," are required to separate the data items from one another.

Data Formats

Query messages use the formats outlined in the table below. The format is selected according to the command.

Response Messages and Parameter Data Types

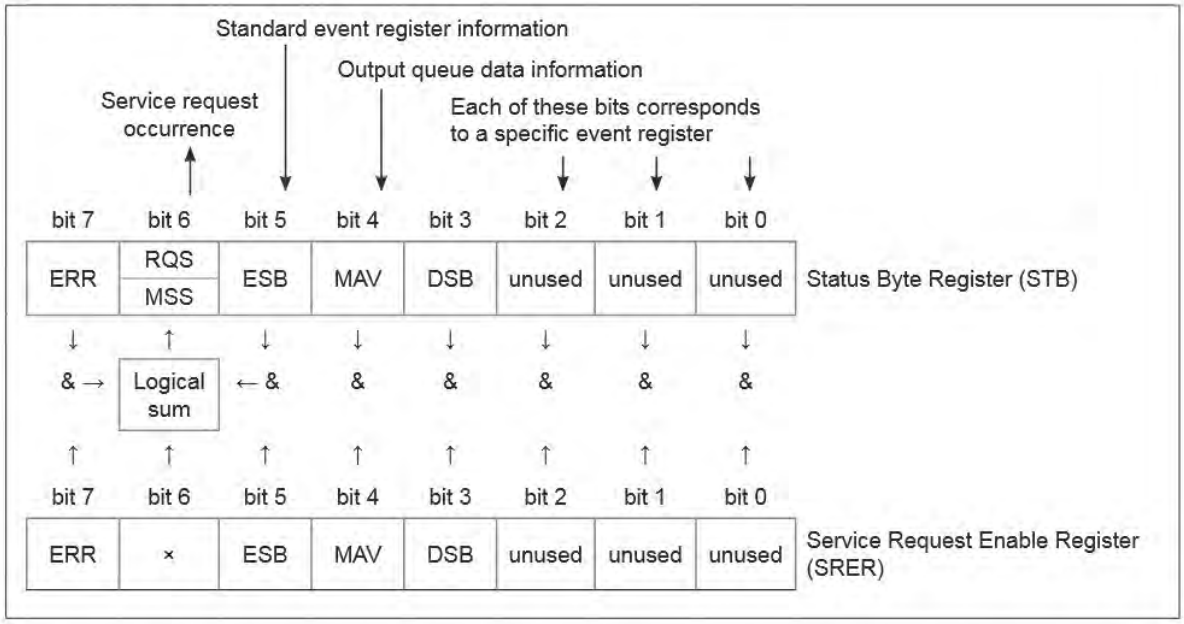
Data type	Description	Example	Remarks
NR1	Integer	0, 1, 2, 3 etc.	Setting items, etc.
NR2	Fixed-point decimal number	+12.345, 400.0 etc.	Primarily setting values
NR3	Floating-point decimal number	+1.234±50 etc.	Primarily settings and measured values
ASCII	ASCII string	XXXXXXXXXXXXXXXX	Primarily device IDs

1.888.610.7664 www.calcert.com sales@calcert.com

Status Byte Register

RS-232C : RS-232C reads the status bytes to find out the status of the device.
GP-IB : The device adopts the IEEE488.1-1987 defined status model for parts related to the serial polling performed by the service request function. A trigger for generating a service request is called an event.

Overview of Service Request Occurrence



The Status Byte Register contains information about the event registers and the output queue. Required items are selected from this information by masking with the Service Request Enable Register. When any bit selected by the mask is set, bit 6 (MSS; the Master Summary Status) of the Status Byte Register is also set, which generates an SRQ (Service Request) message and dispatches a service request.

For RS-232C, bit 4 (MAV message available) of the status byte register is not set.

1.888.610.7664 www.calcert.com sales@calcert.com

Status Byte Register (STB)

A status byte register is an 8-bit register output from the unit to the controller during serial polling. If even one of the status byte register bits enabled by the service request enable register changes from "0" to "1" the MSS bit becomes 1. At the same time, the RQS bit also becomes "1" and a service request is generated.

The RQS bit is always synchronized with the service request and only read and simultaneously cleared upon being serial polled. The MSS bit is only read by an "`*STB?`" query and is not cleared until the event is cleared by a command such as a "`*CLS`" command.

Bit 7	ERR	Unrecoverable error
Bit 6	RQS MSS	Set to "1" when a service request is dispatched. This is the logical sum of the other bits of the Status Byte Register.
Bit 5	ESB	Standard Event Status (logical sum) bit This is logical sum of the Standard Event Status Register.
Bit 4	MAV	Message available Indicates that a message is present in the output queue.
Bit 3	DSB	Event Status (logical sum) bit This is the logical sum of Event Status Register.
Bit 2	–	Unused
Bit 1	–	Unused
Bit 0	–	Unused

Service Request Enable Register (SRER)

This register masks the Status Byte Register. Setting a bit of this register to "1" enables the corresponding bit of the Status Byte Register to be used.

Event Register

Standard Event Status Register (SESR)

A standard event status register is an 8-bit register.

If any bit in the Standard Event Status Register is set to "1" (after masking by the Standard Event Status Enable Register), bit 5 (ESB) of the Status Byte Register is set to "1".
Refer to "Standard Event Status Enable Register (SESER)" (p. 32)

The standard event status register is cleared at the following times:
- When a "`*CLS`" command is executed
- When a "`ERR?`" command is executed
- When the device power is cycled

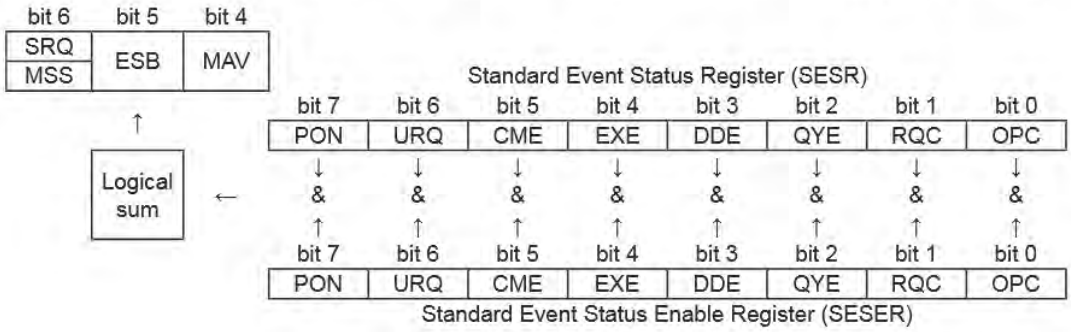
1.888.610.7664 www.calcert.com sales@calcert.com

Bit 7	PON	Power-On Flag Set to "1" when the power is turned on, or upon recovery from an outage.
Bit 6	URQ	User Request Unused
Bit 5	CME	Command error (The command to the message terminator is ignored.) This bit is set to "1" when a received command contains a syntactic or semantic error: • Program header error • Incorrect number of data parameters • Invalid parameter format • Received a command not supported by the device
Bit 4	EXE	Execution Error This bit is set to "1" when a received command cannot be executed for some reason. • The specified data value is outside of the set range • The specified setting data cannot be set • Execution is prevented by some other operation being performed
Bit 3	DDE	Device-Dependent Error This bit is set to "1" when a command cannot be executed due to some reason other than a command error, a query error or an execution error. • When the command cannot be executed because there is an internal anomaly
Bit 2	QYE	Query Error (the output queue is cleared) This bit is set to "1" when a query error is detected by the controller of the output queue. • When an attempt has been made to read an empty output queue (GP-IB only) • When the data overflows the output queue • When data in the output queue has been lost
Bit 1	RQC	Request Control Unused
Bit 0	OPC	Operation Complete This bit is set to "1" in response to an "*OPC" command. • It indicates the completion of operations of all messages up to the "*OPC" command

Standard Event Status Enable Register (SESER)

Setting any bit of the Standard Event Status Enable Register to "1" enables access to the corresponding bit of the Standard Event Status Register.

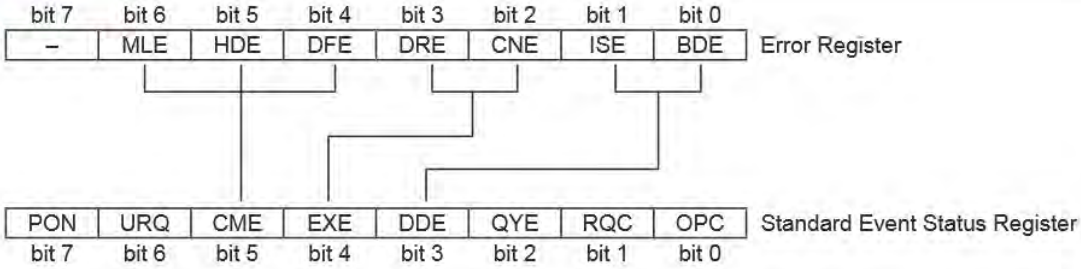
Standard Event Status Register (SESR) and Standard Event Status Enable Register (SESER)



Error Register

The Error Register, which consists of 8 bits, manages error information. The contents of this register are aggregated in the CME, EXE, DDE, and QYE bits of the Standard Event Status Register (no mask processing is performed).
Error register-related message are listed below.

*CLS	Clears the following registers: • Status Byte Register • Standard Event Status Register • Error Register
ERR?	Queries and clears the Error Register.



MLE: Message Length Error
HDE: Header Error
DFE: Data Format Error
DRE: Data Range Error
CNE: Can Not Execute
ISE: Internal communication Error
BDE: Environment Backup was Damaged (RAM)

Error Register structure

Bit No.	Name	Event/status indicated by set bit
Bit 7	–	Unused
Bit 6	MLE	Message Length Error Set when the message length exceeds the allowable range. The bit is reset after the register is read.
Bit 5	HDE	Message Header Error Set when an unrecognizable message header is received. The bit is reset after the register is read.
Bit 4	DFE	Data Format Error Set when the number of parameters exceeds the stipulated number or when there is an unrecognizable parameter. The bit is reset after the register is read.
Bit 3	DRE	Data Range Error Set when a parameter falls outside the stipulated range. The bit is reset after the register is read.
Bit 2	CNE	Unexecutable command Set when an unexecutable command is received. The bit is reset after the register is read.
Bit 1	ISE	Internal communication error Set when an internal communication error occurs. The bit is reset after the register is read.
Bit 0	BDE	Environment backup was damaged Set when data stored in the device's backup RAM is corrupted. The bit is reset after the register is read.

1.888.610.7664 www.calcert.com sales@calcert.com

3.6 Message List

RS-232C-only commands are indicated by **RS-232C** . When using the RS-232C interface to send commands, include a uniform wait time of 100 ms (excluding the following exceptions).

Command	Description	Format
Communication condition		
RMT	Remote switching request **RS-232C**	[Format] RMT
Delimiter		
DLM	Talker delimiter specification d1 (delimiter specification: 0 to 2) 0: LF<EOI> Default 1: CRLF<EOI> 2: <EOI> Note: This setting reverts to its default when the device is powered on. A combination CR+LF is used as the RS-232C delimiter for both data transmission and reception.	[Format] DLM d1 d1: NR1 format
DLM?	Delimiter query The contents of responses are the same as the settings.	[Format] DLM? [Response] d1
Output voltage setting		
VAI	Circuit A output voltage setting d1: 1.0 V to 1000.0 V Note: Set as an absolute value. The valid setting range varies with the model.	[Format] VAI d1 d1: NR2 format
VAI?	Circuit A output voltage setting query The contents of responses are the same as the settings.	[Format] VAI? [Response] d1
VBI	Circuit B output voltage setting d1: 1.0 V to 1000.0 V Note: Set as an absolute value. The valid setting range varies with the model.	[Format] VBI d1 d1: NR2 format
VBI?	Circuit B output voltage setting query The contents of responses are the same as the settings.	[Format] VBI? [Response] d1
	Output voltage setting range by model	

Model	Lower limit (V)	Upper limit (V)
SM7860-51, -61	1.0	500.0
SM7860-52, -62	250.0	1000.0
SM7860-53, -63	1.0	500.0
SM7860-54, -64	250.0	1000.0
SM7860-55, -65	1.0	500.0
SM7860-56, -66	250.0	1000.0
SM7860-57, -67	1.0	10.0
SM7860-58, -68	1.0	500.0

Alarm setting		
ARM	Voltage error alarm setting d1: 2% to 19%, Circuit A voltage error alarm setting d2: 2% to 19%, Circuit B voltage error alarm setting Note: d1 or d2 can be omitted.	[Format] ARM d1,d2 ARM d1 ARM ,d2
ARM?	Voltage error alarm setting query The contents of responses are the same as the settings.	[Format] ARM? [Response] d1,d2

1.888.610.7664 www.calcert.com sales@calcert.com

Command	Description	Format
Voltage monitor		
VMA?	Circuit A power supply voltage monitor value query	[Format] VMA? [Response] d1: NR2 format
VMB?	Circuit B power supply voltage monitor value query	[Format] VMB? [Response] d1: NR2 format
Output current limit		
CLM	OUT1 to OUT4[mA]: 2 to 50 mA Note: The valid setting range varies by model.	[Format] CLM d1,d2,d3,d4
CLM?	Current limit setting value query	[Format] CLM? [Response] d1 to d4: NR1 format
LCD display mode		
LCD	LCD display mode setting d1 (Display mode: 0 to 1) 0: OFF (Display off) 1: ON (Display on)	[Format] LCD d1 d1: NR1 format
LCD?	LCD display mode query The contents of responses are the same as the settings.	[Format] LCD? [Response] d1: NR1 format
PAG	LCD display page specification d1 (Page number: 0 to 1) 0: Output voltage setting, monitor voltage value, channel-specific output setting state 1: Alarm setting, GP-IB address	[Format] PAG d1 d1: NR1 format
Error information		
ERR?	Error information query d1 (Error information: 0 to 127) Note: Error information is cleared when the response is output.	[Format] ERR? [Response] d1: NR1 format
Others		
*RST	Resets the device Restore all the settings to the factory default (except for the output setting for the device interlocked). Device operation will be stopped.	[Format] *RST
*IDN?	Hardware ID query Returns the device's hardware ID as the response. d1 (HIOKI, SM7860-5x, 0, 01.00) or d1 (HIOKI, SM7860-6x, 0, 01.00)	[Format] *IDN? [Response] d1: String
*SAV	Save environmental data (output voltage setting, current limit value, and alarm setting) d1 (Environmental data no.: 0 to 3)	[Format] *SAV d1 d1: NR1 format
*RCL	Recall environmental data (output voltage setting, current limit value, and alarm setting) d1 (Environmental data no.: 0 to 3)	[Format] *RCL d1 d1: NR1 format
*CLS	Clear status register	[Format] *CLS
*SRE	Sets the service request enable register. d1 (0 to 255)	[Format] *SRE d1 d1: NR1 format
*SRE?	Service request enable register query d1 (0 to 63, 128 to 191) Note: Bit 6 is not set by *SRE.	[Format] *SRE? [Response] d1: NR1 format
*STB?	Status byte register query d1 (0 to 255)	[Format] *STB? [Response] d1: NR1 format
*ESE	Sets the standard event status enable register. d1 (0 to 255)	[Format] *ESE d1 d1: NR1 format

1.888.610.7664 www.calcert.com sales@calcert.com

Command	Description	Format
*ESE?	Standard event status enable register query The contents of responses are the same as the settings.	[Format] *ESE? [Response] d1: NR1 format
*ESR?	Standard event status register query d1 (0 to 255)	[Format] *ESR? [Response] d1: NR1 format
*OPC	Sets the standard event status register's OPC bit after all ongoing operations have completed. This command is used to detect the completion of commands that involve time-consuming processing.	[Format] *OPC
*OPC?	Returns the value "1" when all ongoing operations have completed. d1: 1	[Format] *OPC? [Response] d1: NR1 format
CNF	Operating environment setting d1 (Interlock control enable/disable: 0 to 1) 0: CONNECT (Enables interlock) 1: CUTOFF (Disables interlock) Default	[Format] CNF d1 d1: NR1 format
CNF?	Operating environment query The contents of responses are the same as the settings.	[Format] CNF? [Response] d1
KLC	Key lock setting d1 (0 to 1) 0: Key lock off 1: Key lock on	[Format] KLC d1 d1: NR1 format
KLC?	Key lock query d1 (0 to 1) The contents of responses are the same as the settings.	[Format] KLC? [Response] d1: NR1 format

3.7 Listener Specification Precautions

Input buffer size

Multiple command messages can be transferred at once by joining them with message separators. Since the device provides an 128-byte input buffer, the device is unable to receive message strings in excess of 127 characters in length. In this case, the entire command will be ignored (discarded), and the Error Register's MLE (Message Length Error) bit will be set.

Reading from the output buffer

The output buffer uses a FIFO design, with older data being read first. Consequently, the read value may differ from the expected value under certain circumstances, for example if no response is acquired after issuing a query. Additionally, the output buffer is 511 bytes in size. If data in excess of 511 bytes is written to the buffer, it will be discarded, and the Error Register's QYE (Query Error) bit will be set.

1.888.610.7664 www.calcert.com sales@calcert.com

4 External Control

This chapter describes how to use the EXT I/O connector on the rear of the device to control the device.

4.1 EXT I/O Connector and Signals

⚠ WARNING

To prevent an electric shock or damage to the equipment, always observe the following precautions when connecting the cables to EXT I/O connector:

- **Always turn off the device and any devices to be connected before making connections.**
- **During operation, a wire becoming dislocated and contacting another conductive object can be serious hazard. Use bail locks to secure the EXT I/O connector.**
- **Ensure that devices and systems to be connected to the EXT I/O connector are properly isolated from one another.**

⚠ CAUTION

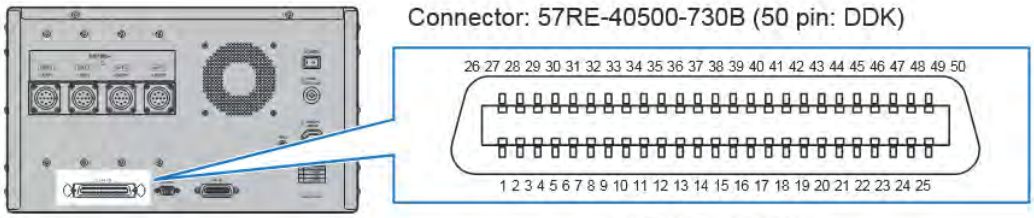
To avoid damage to the device, observe the following cautions:

- Do not apply voltage or current to the EXT I/O connector that exceeds their ratings.
- When driving relays, be sure to install diodes to absorb counter-electromotive force.

Refer to “Connector Type and Signal Pinouts” (p. 38)

1.888.610.7664 www.calcert.com sales@calcert.com

Connector Type and Signal Pinouts



EXT I/O connector

Pin No.	Signal name	I/O
1	COM	–
2	EXT_DCV2 (+24V)	Input
3	$\overline{\text{OUTPUT}}$	Input
4	$\overline{\text{OUT1 (1)_ON}}$	Input
5	$\overline{\text{OUT1 (3)_ON}}$	Input
6	$\overline{\text{OUT1 (5)_ON}}$	Input
7	$\overline{\text{OUT1 (7)_ON}}$	Input
8	$\overline{\text{OUT2 (1)_ON}}$	Input
9	$\overline{\text{OUT2 (3)_ON}}$	Input
10	$\overline{\text{OUT2 (5)_ON}}$	Input
11	$\overline{\text{OUT2 (7)_ON}}$	Input
12	$\overline{\text{OUT3 (1)_ON}}$	Input
13	$\overline{\text{OUT3 (3)_ON}}$	Input
14	$\overline{\text{OUT3 (5)_ON}}$	Input
15	$\overline{\text{OUT3 (7)_ON}}$	Input
16	$\overline{\text{OUT4 (1)_ON}}$	Input
17	$\overline{\text{OUT4 (3)_ON}}$	Input
18	$\overline{\text{OUT4 (5)_ON}}$	Input
19	$\overline{\text{OUT4 (7)_ON}}$	Input
20	(Reserved)	–
21	(Reserved)	–
22	(Reserved)	–
23	(Reserved)	–
24	$\overline{\text{ALARM}}$	Output
25	$\overline{\text{TEMP}}$	–

Pin No.	Signal name	I/O
26	COM	–
27	EXT_DCV2 (+24V)	Input
28	$\overline{\text{INTERLOCK}}$	Input
29	$\overline{\text{OUT1 (2)_ON}}$	Input
30	$\overline{\text{OUT1 (4)_ON}}$	Input
31	$\overline{\text{OUT1 (6)_ON}}$	Input
32	$\overline{\text{OUT1 (8)_ON}}$	Input
33	$\overline{\text{OUT2 (2)_ON}}$	Input
34	$\overline{\text{OUT2 (4)_ON}}$	Input
35	$\overline{\text{OUT2 (6)_ON}}$	Input
36	$\overline{\text{OUT2 (8)_ON}}$	Input
37	$\overline{\text{OUT3 (2)_ON}}$	Input
38	$\overline{\text{OUT3 (4)_ON}}$	Input
39	$\overline{\text{OUT3 (6)_ON}}$	Input
40	$\overline{\text{OUT3 (8)_ON}}$	Input
41	$\overline{\text{OUT4 (2)_ON}}$	Input
42	$\overline{\text{OUT4 (4)_ON}}$	Input
43	$\overline{\text{OUT4 (6)_ON}}$	Input
44	$\overline{\text{OUT4 (8)_ON}}$	Input
45	(Reserved)	–
46	(Reserved)	–
47	(Reserved)	–
48	(Reserved)	–
49	$\overline{\text{BUSY}}$	Output
50	(Reserved)	–

Do not connect to reserved pins.

1.888.610.7664 www.calcert.com sales@calcert.com

Signal Functions

Input Signals

EXT_DCV2 (+24V)	External power source input
$\overline{\text{OUTPUT}}$	Output on/off setting
$\overline{\text{OUT1 (1)_ON}}$ to $\overline{\text{OUT1 (8)_ON}}$	Specific-channel on/off setting
$\overline{\text{OUT2 (1)_ON}}$ to $\overline{\text{OUT2 (8)_ON}}$	Specific-channel on/off setting
$\overline{\text{OUT3 (1)_ON}}$ to $\overline{\text{OUT3 (8)_ON}}$	Specific-channel on/off setting
$\overline{\text{OUT4 (1)_ON}}$ to $\overline{\text{OUT4 (8)_ON}}$	Specific-channel on/off setting
$\overline{\text{INTERLOCK}}$	When on, no voltage can be generated.

- The $\overline{\text{INTERLOCK}}$ signal cannot be used unless it has been enabled with the operating environment setting (CNF=0).
- The device ships with this setting disabled (CNF=1).
  Refer to “CNF” (p. 36)
- The output voltage cannot be changed while the $\overline{\text{OUTPUT}}$ signal is enabled.

Output Signals

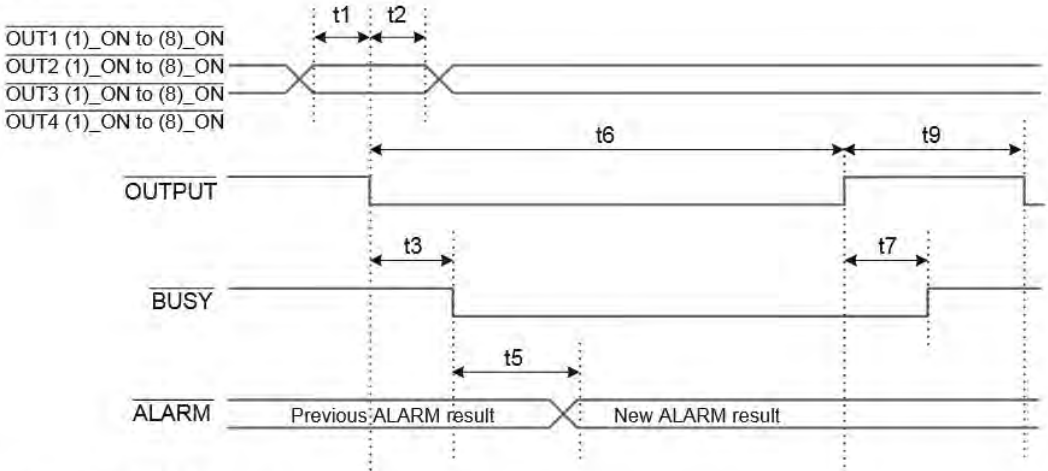
$\overline{\text{ALARM}}$	Generated voltage alarm
$\overline{\text{BUSY}}$	Voltage being output
$\overline{\text{TEMP}}$	Temperature alarm

1.888.610.7664 www.calcert.com sales@calcert.com

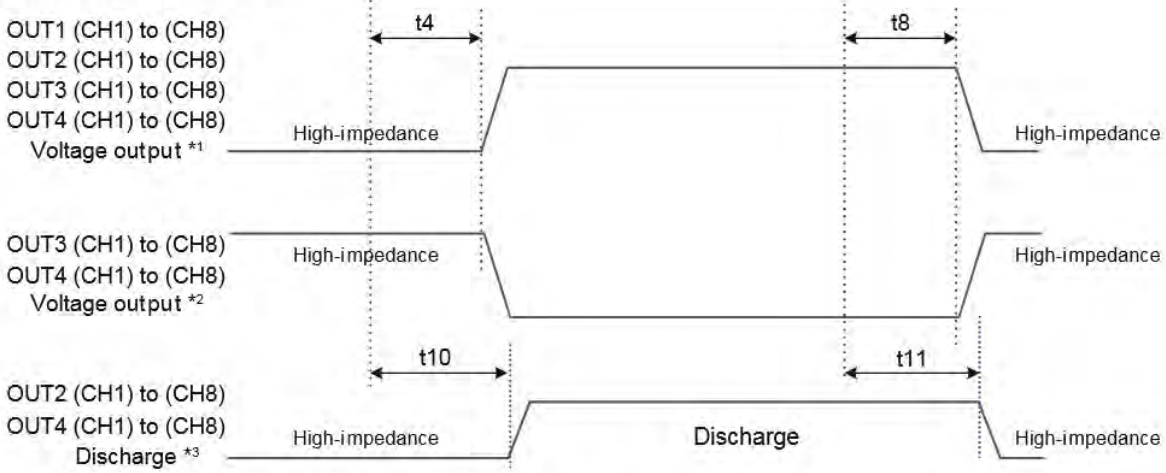
4.2 Timing Chart

Each signal level indicates a corresponding voltage level.

EXT I/O connector



Voltage output terminal



States of the voltage output terminals follow any one of the patterns with *1 through *3 depending on models.

*1 SM7860-51, -52, -61, -62: OUT1 to OUT4
SM7860-53, -54, -63, -64: OUT1 to OUT2
SM7860-55, -56, -65, -66: OUT1
SM7860-57, -58, -67, -68: OUT1 to OUT3

*2 SM7860-53, -54, -63, -64: OUT3 to OUT4
SM7860-55, -56, -65, -66: OUT3

*3 SM7860-55, -56, -65, -66: OUT2, OUT4
SM7860-57, -58, -67, -68: OUT4

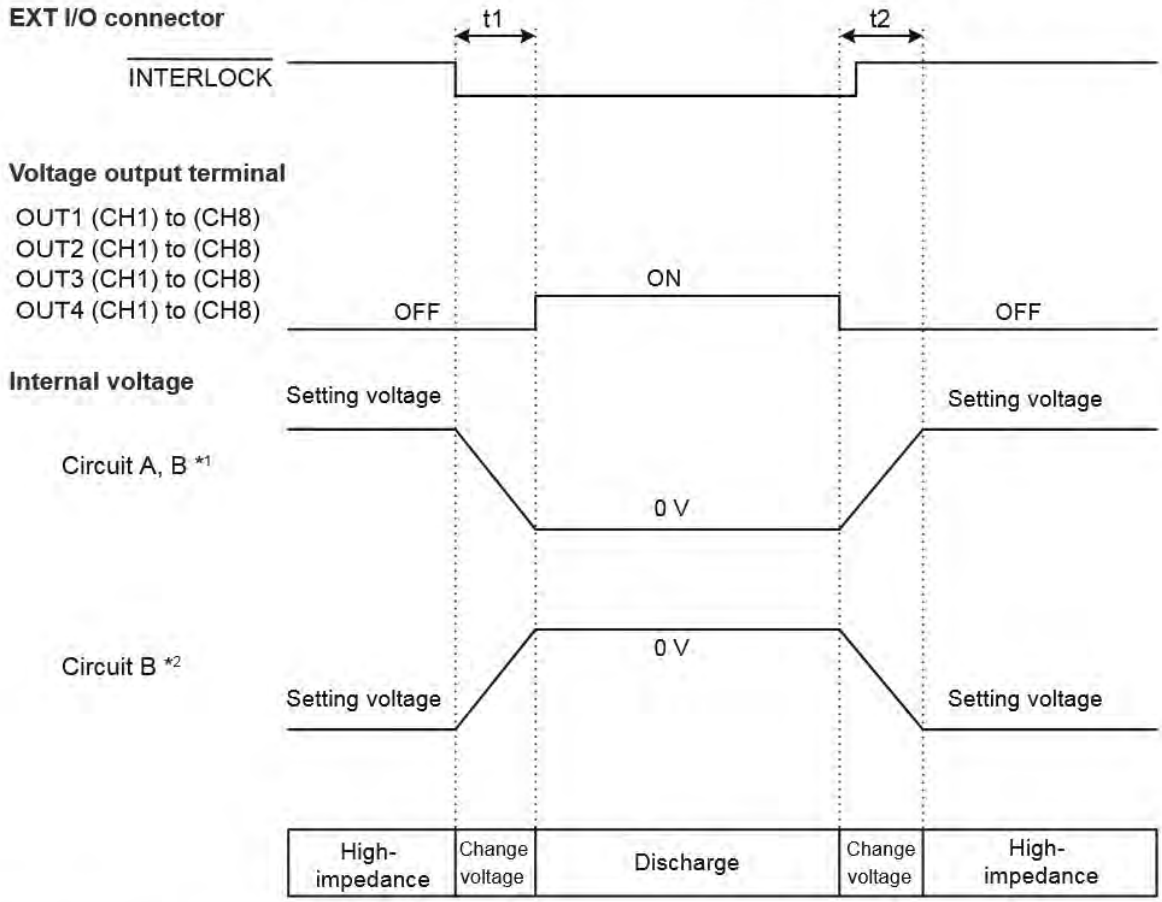
1.888.610.7664 www.calcert.com sales@calcert.com

Timing Chart Interval Descriptions

Interval	Description	Duration
t1	Channel setup time	100 μs or more
t2	Channel hold time	200 μs or more
t3	Output on → Busy delay time	200 μs or less
t4	Output on → Voltage output delay time	600 μs or less
t5	Alarm delay time	3.5 ms or less
t6	Output pulse width	8 ms or more
t7	Output off → Busy delay time	800 μs or less
t8	Output off → Voltage output delay time	2.5 ms or less
t9	Output off time	4 ms or more
t10	Output on → Discharging start delay time	1.2 ms or less
t11	Output off → Discharging complete delay time	1.1 ms or less

1.888.610.7664 www.calcert.com sales@calcert.com

When the output setting for the device interlocked is set to the discharging state



The internal voltage follows either the pattern with *1 or that with *2 depending on models.

*1 SM7860-51, -52, -61, -62: OUT1 to OUT4
SM7860-53, -54, -63, -64: OUT1 to OUT2
SM7860-55, -56, -65, -66: OUT1
SM7860-57, -58, -67, -68: OUT1 to OUT3

*2 SM7860-53, -54, -63, -64: OUT3 to OUT4
SM7860-55, -56, -65, -66: OUT3

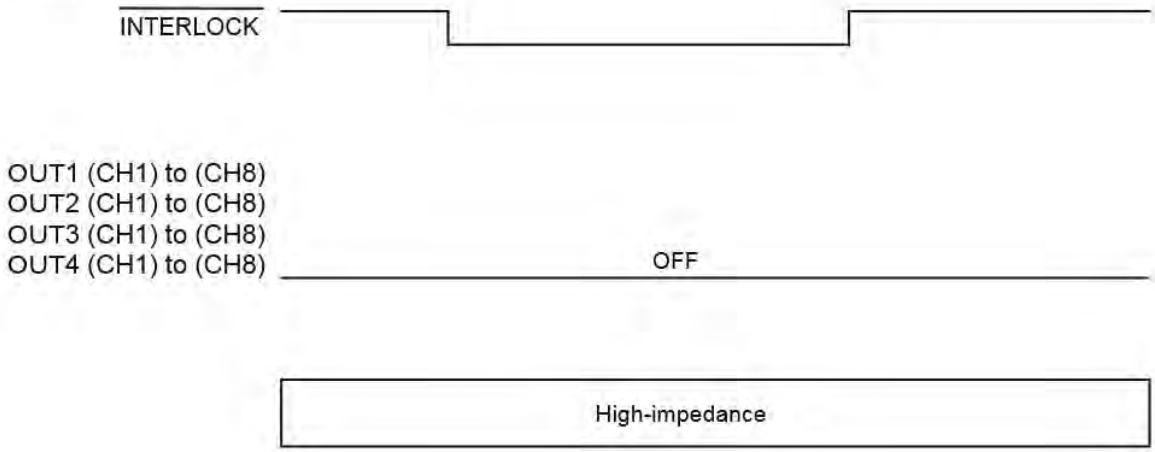
Interval	Description	Duration
t1	Time taken for the internal voltage to decrease from the specified voltage to 0 V	Not specified
t2	Time taken for the internal voltage to increase from 0 V to the specified voltage	7 s or less*3

*3 The device does not accept any signals inputted into the EXT I/O connector during this period.

1.888.610.7664 www.calcert.com sales@calcert.com

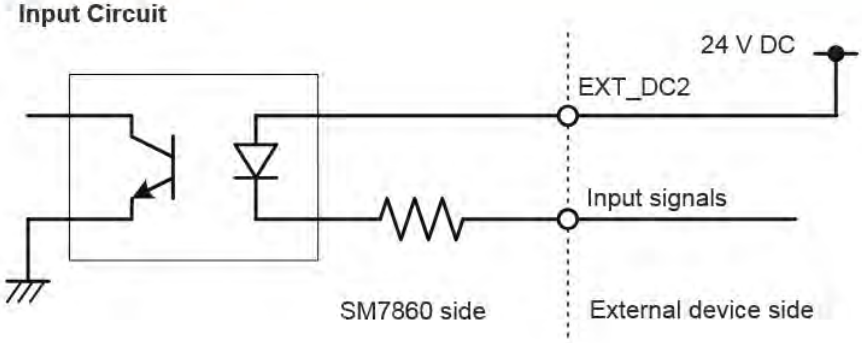
When the output setting for the device interlocked is set to the high-impedance state

EXT I/O connector

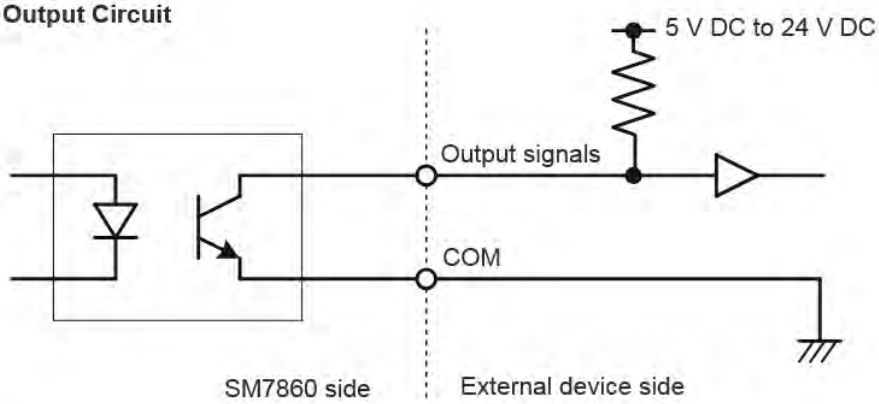


4.3 Internal Circuitry

Input Circuit



Output Circuit



Input Signals	Input method	Photocoupler-isolated input
	Input voltage	Input voltage LOW: 0 V to 0.5 V, HIGH: 24 V±10%
Output Signals	Output method	Photocoupler-open collector output
	Output voltage/ current	LOW < 0.5 V, HIGH > 5 V to 24 V (depends on external voltage), Max. 5 mA

1.888.610.7664 www.calcert.com sales@calcert.com

5 Specifications

5.1 General Specifications

Operating environment	Indoors, Pollution degree 2, up to 2000 m (6562 ft.)
Operating temperature and humidity	0°C to 60°C (32°F to 140°F), 80% RH or less (no condensation)
Storage temperature and humidity	−10°C to 55°C (14°F to 131°F), 80% RH or less (no condensation)
Power supply	Rated supply voltage SM7860-51, -52, -53, -54, -55, -56, -57, -58: 100 V AC to 110 V AC SM7860-61, -62, -63, -64, -65, -66, -67, -68: 220 V AC (Voltage fluctuations of ±10% from the rated supply voltage are taken into account.) Rated supply frequency: 50 Hz, 60 Hz Anticipated transient overvoltage: 2500 V
Maximum rated power	860 VA
Interface	RS-232C, GP-IB
Dimensions	Approx. 425W × 249H × 581D mm (16.73″W × 9.80″H × 22.87″D)
Mass	Approx. 47 kg (1657.8 oz.) (SM7860-51, -52, -53, -54, -55, -56, -58, -61, -62, -63, -64, -65, -66, -68) Approx. 34 kg (1199.3 oz.) (SM7860-57, -67)
Accessories	See “Device and Accessories” (p. 3)
Options	See “Options” (p. 3)
Replacement part	Fuse: MF60NRF-8A (250V M 8.0A ϕ6.4×30 mm)
Product warranty period	3 years

1.888.610.7664 www.calcert.com sales@calcert.com

5.2 Basic Specifications

Configuration

Model	Item	Circuit A	Circuit B
SM7860-51 SM7860-61	Maximum output current	430 mA (200 VA)	430 mA (200 VA)
	Output voltage range	1.0 V to 500.0 V (0.1 V resolution)	1.0 V to 500.0 V (0.1 V resolution)
	Channels	OUT 1 (1) to (8) : Voltage output OUT 2 (1) to (8) : Voltage output	OUT 3 (1) to (8) : Voltage output OUT 4 (1) to (8) : Voltage output
	Current limit	±(2 mA to 50 mA) /CH	±(2 mA to 50 mA) /CH
SM7860-52 SM7860-62	Maximum output current	100 mA (100 VA)	100 mA (100 VA)
	Output voltage range	250.0 V to 1000.0 V (0.1 V resolution)	250.0 V to 1000.0 V (0.1 V resolution)
	Channels	OUT 1 (1) to (8) : Voltage output OUT 2 (1) to (8) : Voltage output	OUT 3 (1) to (8) : Voltage output OUT 4 (1) to (8) : Voltage output
	Current limit	±(2 mA to 10 mA) /CH	±(2 mA to 10 mA) /CH
SM7860-53 SM7860-63	Maximum output current	430 mA (200 VA)	430 mA (200 VA)
	Output voltage range	1.0 V to 500.0 V (0.1 V resolution)	−1.0 V to −500.0 V (0.1 V resolution)
	Channels	OUT 1 (1) to (8) : Voltage output OUT 2 (1) to (8) : Voltage output	OUT 3 (1) to (8) : Voltage output OUT 4 (1) to (8) : Voltage output
	Current limit	±(2 mA to 50 mA) /CH	±(2 mA to 50 mA) /CH
SM7860-54 SM7860-64	Maximum output current	100 mA (100 VA)	100 mA (100 VA)
	Output voltage range	250.0 V to 1000.0 V (0.1 V resolution)	−250.0 V to −1000.0 V (0.1 V resolution)
	Channels	OUT 1 (1) to (8) : Voltage output OUT 2 (1) to (8) : Voltage output	OUT 3 (1) to (8) : Voltage output OUT 4 (1) to (8) : Voltage output
	Current limit	±(2 mA to 10 mA) /CH	±(2 mA to 10 mA) /CH
SM7860-55 SM7860-65	Maximum output current	430 mA (200 VA)	430 mA (200 VA)
	Output voltage range	1.0 V to 500.0 V (0.1 V resolution)	−1.0 V to −500.0 V (0.1 V resolution)
	Channels	OUT 1 (1) to (8) : Voltage output OUT 2 (1) to (8) : Discharge	OUT 3 (1) to (8) : Voltage output OUT 4 (1) to (8) : Discharge
	Current limit	±(2 mA to 50 mA) /CH	±(2 mA to 50 mA) /CH

1.888.610.7664 www.calcert.com sales@calcert.com

Model	Item	Circuit A	Circuit B
SM7860-56 SM7860-66	Maximum output current	100 mA (100 VA)	100 mA (100 VA)
	Output voltage range	250.0 V to 1000.0 V (0.1 V resolution)	−250.0 V to −1000.0 V (0.1 V resolution)
	Channels	OUT 1 (1) to (8) : Voltage output OUT 2 (1) to (8) : Discharge	OUT 3 (1) to (8) : Voltage output OUT 4 (1) to (8) : Discharge
	Current limit	±(2 mA to 10 mA) /CH	±(2 mA to 10 mA) /CH
SM7860-57 SM7860-67	Maximum output current	430 mA (4 VA)	430 mA (4 VA)
	Output voltage range	1.0 V tp 10.0 V (0.1 V resolution)	1.0 V to 10.0 V (0.1 V resolution)
	Channels	OUT 1 (1) to (8) : Voltage output OUT 2 (1) to (8) : Voltage output	OUT 3 (1) to (8) : Voltage output OUT 4 (1) to (8) : Discharge
	Current limit	±(2 mA to 50 mA) /CH	±(2 mA to 50 mA) /CH
SM7860-58 SM7860-68	Maximum output current	430 mA (200 VA)	430 mA (200 VA)
	Output voltage range	1.0 V to 500.0 V (0.1 V resolution)	1.0 V to 500.0 V (0.1 V resolution)
	Channels	OUT 1 (1) to (8) : Voltage output OUT 2 (1) to (8) : Voltage output	OUT 3 (1) to (8) : Voltage output OUT 4 (1) to (8) : Discharge
	Current limit	±(2 mA to 50 mA) /CH	±(2 mA to 50 mA) /CH

Maximum rated voltage to earth	1000 V DC, maximum generated internal voltage of 1320 V DC
Output terminals	Special round connector (support for 8 channels), withstand voltage of 1000 V, isolated channels
LED indicator	POWER, voltage output indicator, inter-lock
LCD screen	P1: Output voltage setting, monitor voltage value, channel-specific output setting state P2: Alarm setting, GP-IB address, output setting for the device interlocked
Key	▲▼ (for toggling display)

1.888.610.7664 www.calcert.com sales@calcert.com

Functions Specification

Voltage output function	
Operating method	Sink/source (support for charging and discharging)
Output voltage setting value	1.0 V to 1000.0 V (set in 0.1 V increments; valid setting range varies by model) Refer to “Configuration” (p. 46) in “5.2 Basic Specifications”)
Generation control	Output only when EXT I/O interface’s $\overline{\text{OUTPUT}}$ signal is on.
Output on/off	Can be set independently for each channel.
Voltage error alarm	Operation: Alarm is generated when the monitor voltage falls outside the set range. Valid setting range : ±2% to ±19% (1% resolution)
Current limit function	
Limit method	Current can be limited independently for each channel.
Limit value setting	2 mA to 50 mA (set in 1 mA increments; valid setting range varies by model) Refer to “Configuration” (p. 46) in “5.2 Basic Specifications”)
Current limit direction	Current can be limited in both directions.
Backup Function	
Backup items	Output voltage setting, alarm setting, GP-IB address
Voltage monitor function	
Voltage monitor	Measures and displays output voltage for each circuit.
Interlock function	
Operation	Interlock is enabled when set to “on,” with low input, or when terminals are shorted. Measurement is disabled, including by device keys and communications commands, when interlock is enabled.
Output setting function for the device interlocked	
Operation	The output setting with the device interlocked can be chosen between an impedance state and a discharging state.
Setting procedure	Cannot be set by sending commands. Press and hold both the scroll keys (**[PAGE UP▲]** and **[PAGE DOWN▼]**) on the right of the screen simultaneously for 3 s. The GP-IB-address assigning screen is displayed. Press and hold both the scroll keys (**[PAGE UP▲]** and **[PAGE DOWN▼]**) again simultaneously for 3 s. The setting screen is displayed. Press either of the scroll keys (**[PAGE UP▲]** or **[PAGE DOWN▼]**) to set the GP-IB-address and turn off the device to confirm the address you entered.
Supported model	Hioki Model SM7420 Super Megohm Meter, Hioki Model SM7810-20 Super MΩ HiTester

Accuracy Specifications

Conditions of guaranteed accuracy	
Guaranteed accuracy period	1 year
Guaranteed accuracy period after adjustment made by Hioki	1 year
Temperature and humidity for guaranteed accuracy	23°C±5°C (73°F±9°F), 80% RH or less
Warm-up time	at least an hour
Power supply frequency	50 Hz/60 Hz ±2 Hz
Voltage generation accuracy	
Output voltage accuracy	±2% of setting ±0.5 V (no load)
Error between channels	±0.01 V or less (no load, between outputs from same circuit)
Voltage monitor accuracy	±2% of output voltage ±0.5 V
Current limit accuracy	±10% of setting ±1 mA

Limitations

Voltage application target	Multi-layer ceramic capacitor
Number of charging channels	Up to 8 channels/circuit
Operating conditions	Charging interval must be greater than or equal to the time calculated from the graphs shown in Figure 1 and Figure 2 below. (Continuous charging is not supported.)

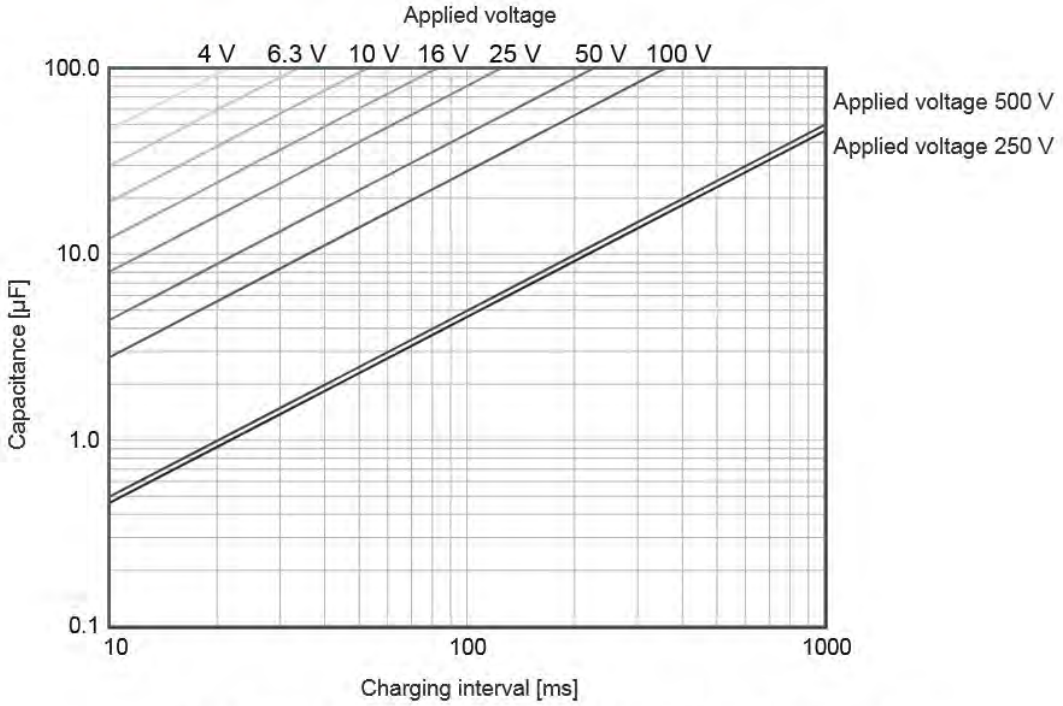


Figure 1: Charging Interval by Applied Voltage and Capacitance
(SM7860-51, -53, -55, -57, -58, -61, -63, -65, -67, -68)

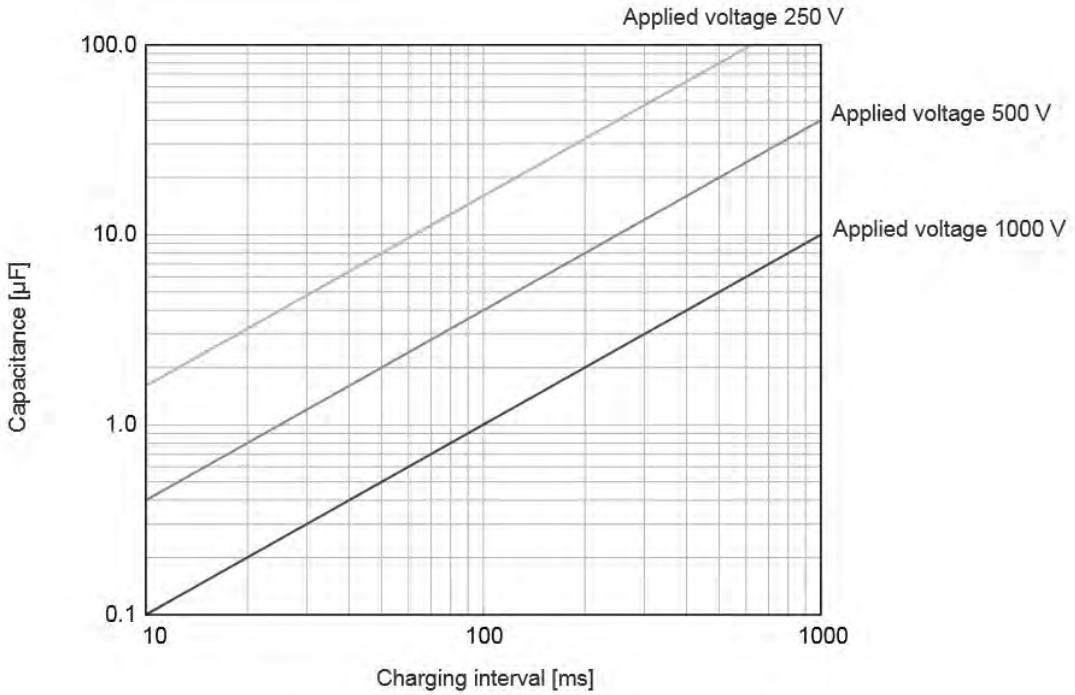


Figure 2: Charging Interval by Applied Voltage and Capacitance
(SM7860-52, -54, -56, -62, -64, -66)

Graph description and operating precautions

Since the SM7860 is designed to be embedded in an automated system in applications in which it charges capacitors, it cannot be used with a continuous load.
Figures 1 and 2 define the minimum cycle times at which this automated system can operate based on the output voltage and capacitor capacitance.

For example, when charging a 25 V, 30 µF capacitor, a charge interval of approximately 37 ms can be read from the point at which a line extending from the 30 µF position on the vertical axis intersects the 25 V line. This figure (37 ms) defines the minimum cycle for the automated system.

The time (T) representing the interval during the 37 ms for which the SM7860 charges the capacitor at the full power of 50 mA or 10 mA can be calculated as follows:

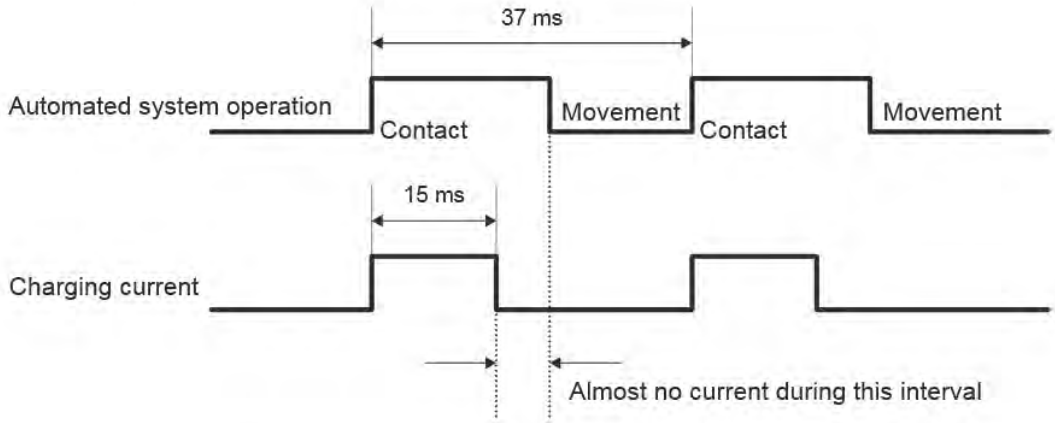
$T = C \times V / I$

C : Capacitor capacitance (µF)
V : Voltage (V)
I : Current (50 mA)

Using values of 25 V, 30 µF, and 50 mA yields:

$T = 30\ \mu F \times 25\ V / 50\ mA$
$= 15\ ms$

The following diagram expresses this as a timing chart:



During the 37 ms interval, the charging current flows for 15 ms, and almost no current flows for the remaining 22 ms. If, for example, the automated system's cycle time were 100 ms instead of 37 ms, the charging current would flow for 15 ms, and almost no current would flow for the remaining 85 ms. This operation describes the normal manner in which the SM7860 is used.

Using the device when there are shorted components:

If the capacitor being charged were shorted, for example due to defective insulation, the charging current would flow for the entire contact interval, rather than just 15 ms. If the test run is expected to include shorted components, check each component before initiating testing and avoid applying current if shorted.

- Design the system so that each of the 32 external input (EXT I/O) signals, from $\overline{\text{OUT1 (1)_ON}}$ to $\overline{\text{OUT4 (8)_ON}}$, can be controlled (turned on and off) independently.
- When outputting voltage from the SM7860, check each capacitor for a short before initiating testing. (Have the automated system store the results of checks performed before testing, for example using capacitance measurement.)
- When a shorted component is encountered, turn the $\overline{\text{OUTX (X)_ON}}$ signal for the shorted component's channel off before turning the external input (EXT I/O) signal's $\overline{\text{OUTPUT}}$ signal on.

Using the device when capacitors are not mounted by the automated system:

When capacitors are not properly mounted from the automated system's part feeder, the architecture of the system may cause the SM7860's output to enter the shorted state. This issue can be addressed in the same manner as described in "Using the device when there are shorted components" above.

1.888.610.7664 www.calcert.com sales@calcert.com

5.3 Input / Output Functions

GP-IB Interface

Data reception	Output voltage setting, output on/off, voltage error alarm setting
Data transmission	Setting read access, error description

RS-232C Interface

Data reception	Output voltage setting, output on/off, voltage error alarm setting
Data transmission	Setting read access, error description
Communication conditions: Refer to “RS-232C Specifications RS-232C” (p. 25)	

EXT I/O Specification

Input/Output signals		
Input	$\overline{\text{OUTPUT}}$	: Output on/off setting
	$\overline{\text{OUT 1 (1)_ON}}$ to $\overline{\text{OUT 1 (8)_ON}}$	: Specific-channel on/off setting
	$\overline{\text{OUT 2 (1)_ON}}$ to $\overline{\text{OUT 2 (8)_ON}}$	: Specific-channel on/off setting
	$\overline{\text{OUT 3 (1)_ON}}$ to $\overline{\text{OUT 3 (8)_ON}}$	: Specific-channel on/off setting
	$\overline{\text{OUT 4 (1)_ON}}$ to $\overline{\text{OUT 4 (8)_ON}}$	: Specific-channel on/off setting
	$\overline{\text{INTERLOCK}}$	: When on, no voltage can be generated.
Output	$\overline{\text{BUSY}}$	: Voltage being output
	$\overline{\text{ALARM}}$	: Generated voltage alarm
	$\overline{\text{TEMP}}$	: Temperature alarm
Electrical characteristics		
Input	Input method	: Photocoupler-isolated input Non-voltage contact input (with current sync/source output support)
	Input on	: Residual voltage 1 V or less Input on: current 4 mA (reference value)
	Input off	: OPEN (breaking current 100 μA or less)
Output	Output method	: Photocoupler-open collector output (non-polar)
	Output voltage/current	: LOW < 0.5 V HIGH > 5 V to 24 V (depends on external voltage) Max. 5 mA
Connector		
	57RE-40500-730B (50 pin : DDK) Pin configuration: Refer to “Connector Type and Signal Pinouts” (p. 38)	

1.888.610.7664 www.calcert.com sales@calcert.com

6 Maintenance and Service

6.1 Troubleshooting

If damage is suspected, check the "If the device malfunctions/before you have it repaired" section below before contacting your authorized Hioki distributor or reseller.

If the device malfunctions/before you have it repaired

Symptom	Cause	Solution	Reference
Neither the screen nor LEDs light up, even when the power is turned on.	Is the power cord properly connected?	Connect the power cord.	p. 16
	Is the power supply fuse installed?	Install the power supply fuse.	p. 56
	Has the power supply fuse been tripped?	Replace the power supply fuse.	p. 56
The device isn't accepting key input.	Is the unit in the key-lock state (indicated by the key-lock display on the screen)?	Cancel the key-lock state.	p. 13 p. 36
Settings cannot be configured from the GP-IB interface.	Do the GP-IB address settings on the device and controller differ?	Set the correct GP-IB address.	p. 14 p. 27
	Did you use the RS-232C interface?	Turn the device off, wait several minutes, and turn the device back on. The GP-IB interface cannot be used immediately after the RS-232C interface is used.	p. 24
Settings cannot be configured from the RS-232C interface.	Did you send the **RMT** command?	Send the **RMT** command first for the RS-232C interface.	p. 28
	Do the controller's RS-232C settings differ from the unit's communications conditions?	Change the controller's RS-232C communications settings.	p. 24 p. 28
	Did you use the GP-IB interface?	Turn the device off, wait several minutes, and turn the device back on. The RS-232C interface cannot be used immediately after the GP-IB interface is used.	p. 24
	Are you using a straight cable?	Use a cross cable.	p. 27
No voltage is being output from the voltage output terminal.	Is the interlock operating? Is the interlock indicator lit up?	The EXT I/O connector's interlock input signal is on. Check the reason that interlock has been activated and rectify it.	p. 10 p. 38
	Is the signal that turns the output channel on being input to the EXT I/O connector?	Set the channel being used to on with the input pins that turn each channel on and off.	p. 38
	Is the signal that turns output on being input to the EXT I/O connector? Does the voltage output indicator light up when output is turned on?	Set the input pin that turns output on and off to on.	p. 38

1.888.610.7664 www.calcert.com sales@calcert.com

Symptom	Cause	Solution	Reference
No voltage is being output from the voltage output terminal. The monitor voltage shown on the screen is **0.0 V**, and the abnormal voltage alarm result is **NG**.	The unit's protective circuitry may have been triggered due to a failure.	Please contact your authorized Hioki distributor or reseller.	p. 13
TEMP is flashing in reverse video on the screen, and a voltage is no longer being output from the voltage output terminal.	The overheat protection function has been activated. Are the limitations listed in the basic specifications being complied with?	Set the operating conditions so that the limitations in the basic specifications are complied with. While **TEMP** is displayed, all channels will be turned off, and the ability to control the unit from the interfaces and EXT I/O connector is disabled. Once the internal temperature decreases, the **TEMP** indicator on the screen will turn off, and you will once more be able to control the unit. All channels will be turned off when the unit resumes operation, so you will need to reconfigure the output channels for use.	p. 13 p. 49
ERROR:011 is being shown in reverse video on the screen, and a voltage is no longer being output from the voltage output terminal.	The power supply A circuit's overcurrent protection function has been activated. Are the limitations listed in the basic specifications being complied with?	Set the operating conditions so that the limitations in the basic specifications are complied with. All channels will turn off, and the device will not accept control instructions from either interface or the EXT I/O connector. There is no way to recover from this state. Turn the unit off, wait a short amount of time, and then turn the unit back on.	p. 13 p. 49
ERROR:012 is being shown in reverse video on the screen, and a voltage is no longer being output from the voltage output terminal.	The power supply B circuit's overcurrent protection function has been activated. Are the limitations listed in the basic specifications being complied with?		

1.888.610.7664 www.calcert.com sales@calcert.com

6.2 Error Display

When an error occurs, it will be displayed in the last row on the screen.

Error Display	Description	Remedy
ERROR:001 Call Service Center	Backup data corrupt	Please contact your authorized Hioki distributor or reseller.
ERROR:002 Call Service Center	Backup data write failure	
ERROR:007 Call Service Center	Power source controller internal communication failure	
ERROR:011 Call Service Center	Power supply circuit A overcurrent	Check "If the device malfunctions/ before you have it repaired" (p. 53)
ERROR:012 Call Service Center	Power supply circuit B overcurrent	

6.3 Repairs, Inspections, and Cleaning

⚠ WARNING

Touching any of the high-voltage points inside the device is very dangerous. Customers are not allowed to modify, disassemble, or repair the device. Doing so may cause a fire, electric shock, or injury.

Cleaning

⚠ CAUTION

Clean the vents periodically to avoid blockage. If a vents becomes clogged, the devices internal cooling is impeded, and damage may result.

- To clean the device, wipe it gently with a soft cloth moistened with water or mild detergent.
- Wipe the screen gently with a soft, dry cloth.

Disposal

Handle and dispose of the device in accordance with local regulations.

Calibrations

The calibration period varies depending on the status of the device or installation environment. We recommend that the calibration period be determined in accordance with the status of the device or installation environment.
Please contact your Hioki distributor to have your device periodically calibrated.

Replaceable Parts and Operating Lifetimes

The characteristics of some of the parts used in the product may deteriorate with extended use.
To ensure the product can be used over the long term, it is recommended to replace these parts on a periodic basis. When replacing parts, please contact your authorized Hioki distributor or reseller.
The service life of parts varies with the operating environment and frequency of use.
Parts are not guaranteed to operate throughout the recommended replacement cycle.

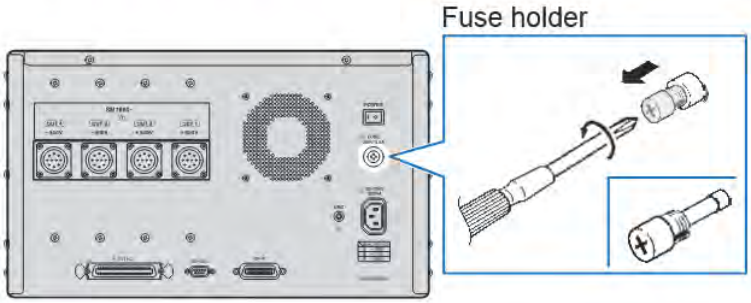
Part name	Recommended replacement cycle
Electrolytic Capacitors	Approx. 10 years
LCD backlight	Approx. 20,000 hours
Relay	Approx. 1 million operations

6.4 Replacing the Power Fuse

⚠ WARNING

- **To avoid electric shock, turn off the power switch and disconnect the connection cables before replacing the fuse.**
- **Replace the fuse only with one of the specified type, characteristics, rated current, and rated voltage. Do not use fuses other than those specified (especially, do not use a fuse with higher-rated current) or do not short circuit and use the fuse holder. Doing so may damage the device and result in bodily injury.**
  Fuse type: MF60NRF-8A f6.4 mm×30 mm Normal-acting fuse

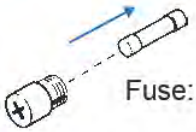
Prepare: Phillips head screwdriver



1 **Turn off the power switch and disconnect the power cord.**

2 **Remove the fuse holder using the Phillips head screwdriver.**

3 **Remove the power fuse from the fuse holder.**



Fuse: ϕ6.4 mm 30 mm, **MF60NRF-8A f6.4 mm 30 mm Normal-acting fuse**

4 **Insert a new power fuse with the specified rating into the fuse holder.**

5 **Insert the fuse holder into its original location and tighten the screw. (Use the Phillips head screwdriver)**

This completes the process of replacing the power fuse.

Warranty Certificate

HIOKI

Model	Serial number	Warranty period Three (3) years from date of purchase (___ / ___)

Customer name: _____

Customer address: _____

Important

- Please retain this warranty certificate. Duplicates cannot be reissued.
- Complete the certificate with the model number, serial number, and date of purchase, along with your name and address. The personal information you provide on this form will only be used to provide repair service and information about Hioki products and services.

This document certifies that the product has been inspected and verified to conform to Hioki's standards.
Please contact the place of purchase in the event of a malfunction and provide this document, in which case Hioki will repair or replace the product subject to the warranty terms described below.

Warranty terms

1. The product is guaranteed to operate properly during the warranty period (three [3] years from the date of purchase). If the date of purchase is unknown, the warranty period is defined as three (3) years from the date (month and year) of manufacture (as indicated by the first four digits of the serial number in YYMM format).
2. If the product came with an AC adapter, the adapter is warrantied for one (1) year from the date of purchase.
3. The accuracy of measured values and other data generated by the product is guaranteed as described in the product specifications.
4. In the event that the product or AC adapter malfunctions during its respective warranty period due to a defect of workmanship or materials, Hioki will repair or replace the product or AC adapter free of charge.
5. The following malfunctions and issues are not covered by the warranty and as such are not subject to free repair or replacement:
   - -1. Malfunctions or damage of consumables, parts with a defined service life, etc.
   - -2. Malfunctions or damage of connectors, cables, etc.
   - -3. Malfunctions or damage caused by shipment, dropping, relocation, etc., after purchase of the product
   - -4. Malfunctions or damage caused by inappropriate handling that violates information found in the instruction manual or on precautionary labeling on the product itself
   - -5. Malfunctions or damage caused by a failure to perform maintenance or inspections as required by law or recommended in the instruction manual
   - -6. Malfunctions or damage caused by fire, storms or flooding, earthquakes, lightning, power anomalies (involving voltage, frequency, etc.), war or unrest, contamination with radiation, or other acts of God
   - -7. Damage that is limited to the product's appearance (cosmetic blemishes, deformation of enclosure shape, fading of color, etc.)
   - -8. Other malfunctions or damage for which Hioki is not responsible
6. The warranty will be considered invalidated in the following circumstances, in which case Hioki will be unable to perform service such as repair or calibration:
   - -1. If the product has been repaired or modified by a company, entity, or individual other than Hioki
   - -2. If the product has been embedded in another piece of equipment for use in a special application (aerospace, nuclear power, medical use, vehicle control, etc.) without Hioki's having received prior notice
7. If you experience a loss caused by use of the product and Hioki determines that it is responsible for the underlying issue, Hioki will provide compensation in an amount not to exceed the purchase price, with the following exceptions:
   - -1. Secondary damage arising from damage to a measured device or component that was caused by use of the product
   - -2. Damage arising from measurement results provided by the product
   - -3. Damage to a device other than the product that was sustained when connecting the device to the product (including via network connections)
8. Hioki reserves the right to decline to perform repair, calibration, or other service for products for which a certain amount of time has passed since their manufacture, products whose parts have been discontinued, and products that cannot be repaired due to unforeseen circumstances.

HIOKI E.E. CORPORATION

18-07 EN-3

1.888.610.7664 www.calcert.com sales@calcert.com

HIOKI

HEADQUARTERS

HIOKI USA CORPORATION

HIOKI (Shanghai) SALES & TRADING CO., LTD.
HIOKI SINGAPORE PTE.LTD.

HIOKI KOREA CO., LTD.

HIOKI EUROPE GmbH

Taiwan Representative Office

MEA Representative Office

1804EN

Edited and published by HIOKI E.E. CORPORATION

・CE declarations of conformity can be downloaded from our website.
・Contents subject to change without notice.
・This document contains copyrighted content.
・It is prohibited to copy, reproduce, or modify the content of this document without permission.
・Company names, product names, etc. mentioned in this document are trademarks or registered trademarks of their respective companies.

1.888.610.7664 www.calcert.com sales@calcert.com